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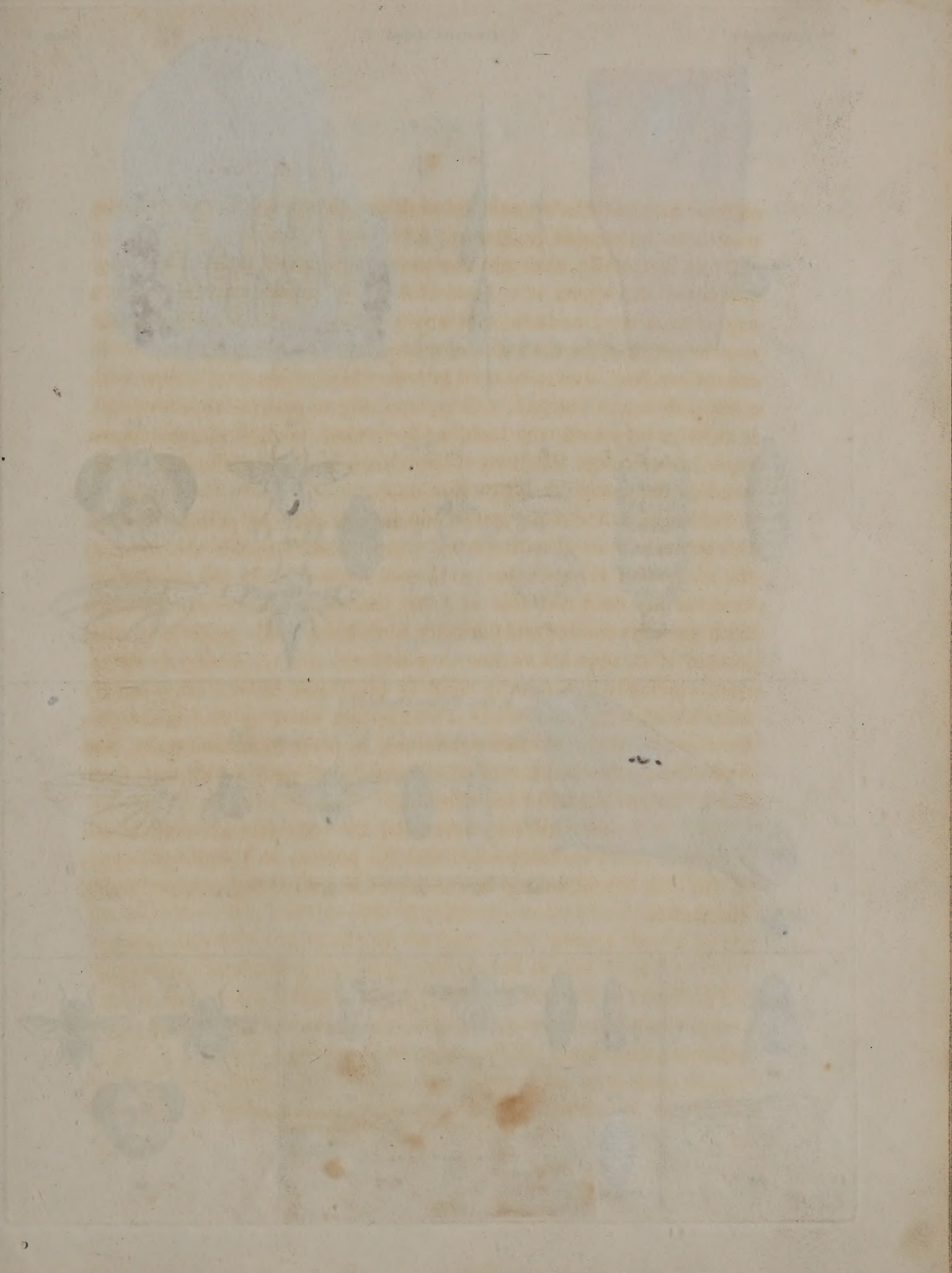

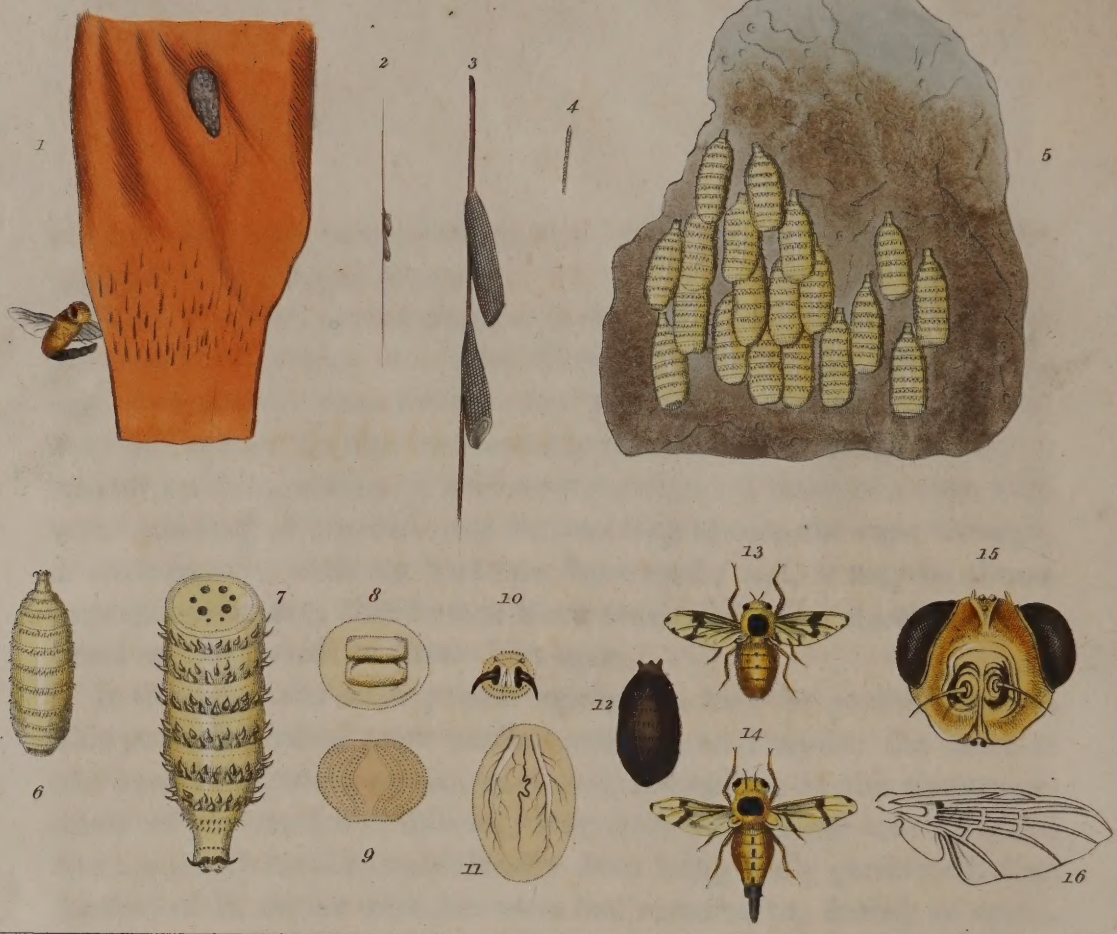

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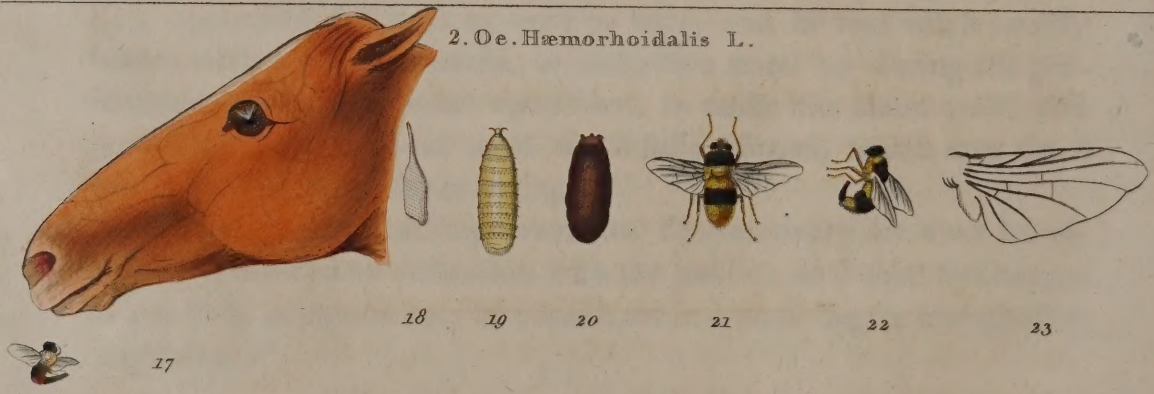

AN ESSAY

ON

THE BOTS OF HORSES,

AND

OTHER ANIMALS.

By BRACY CLARK, F. L. S.

VETERINARY SURGEON.

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ON

THE BOTS, OR OESTRI.

These singular Insects, whose Habitations are the bodies of living animals, are nourished in their Grub or Larva State in an extraordinary way, by feeding upon the juices of these animals, and in their winged state often infest and teaze them, that they could hardly fail of attracting notice, and becoming an object of surprize and curiosity.

This curious race, with us in England, have obtained the name of Botts, or, more correctly, Bots, as the origin of the word would point out as the more proper mode of spelling it. The source or derivation of this appellation did not till very lately occur to me, and was not at all apprehended at the time I wrote an Essay on these Insects, addressed to the Linnean Society, and inserted in the 3d Volume of their Transactions. Our Lexicographers also appear to have been at a loss respecting the true origin of this word, on which we shall venture a suggestion that will appear, we believe, tolerably satisfactory. The derivation of it, we apprehend, is from the French word *Bout*, signifying the extremity or end of a thing, in the way we see it in the words *About*, *Bottom*, *Bottle*, *Botville*, &c.; the last of these alluding to one living at the end or extremity of a town, by elision or for brevity the *u* being omitted. From the same origin also we have *Butts*, houses placed without or at the extremity or end of a town, the *o* in

this case being for brevity omitted. Indeed the instances of its application are very numerous in our language.

The way or reason that these Insects became so designated, is pretty manifest, from the Habits more particularly of the second species of this enumeration, or *Hæmorrhoidalis*, which being fully fed its growth completed, in quitting its habitation in the stomach, and passing through the intestines, does usually hang for some days upon the margin of the Fundament, beneath the tail, then falling to the earth and forming a Chrysalis; and in this state would attract more particular notice and attention, occasioning often serious inconvenience and distress. So situated and observed, it was denoted the *Bout Worm* or *End Worm*, and by contraction *Bot Worm;* and afterwards, for want of better epithets, the appellation became extended to the Fly produced by this worm, and we obtain *Bot Fly*, though it is obvious, as the fly never affects these situations, its application is improper, and has served to disguise and conceal the real origin of the name.

Erroneous and strange notions were entertained in early times of these animals. What views the Romans had of them, we learn from a passage in Vegetius, an elegant veterinary writer in the time of Valentinian, in the fourth century. He says, "When a Humour is found in the anus of the Horse like a boiled bean, it is a sign of this disease (the Coriago) or hide-bound Horse, for *it is a sanies from the wounds* inflicted by small animals in the inside of the beast;*" in which it is evident he alludes to the second species, the hæmorrhoidal or red-tailed Bot, which in hanging, as we have stated, to the extremity of the rectum, corresponds very tolerably in size and appearance to the boiled Bean he compares it to. Still more antiently than

* Hujusmodi passionis signum est (morbus coriaginosus) cum invenitur humor in ano fabæ coctæ similis: est namque sanies ex illis vulneribus que bestiolæ intrinsecus fecerunt. Ed. Manheim, p. 63.

this does Moses in the sacred writings appear to allude to an Insect of this tribe in Egypt, that caused great dread; but of what precise species this should be, we do not venture to make any conjecture.

In the Georgics of Virgil the attack of the Ox-bot upon the herd is strongly delineated, and perhaps correctly. The shrill sound, however, which Virgil describes, we have not been able to perceive; and believe that the agony the fly occasions in depositing the egg in the skin, will account sufficiently for the violent agitation of the herd, without this sound. We, however, mention it, in order to direct the attention of others, who may have the opportunity, to this circumstance, and to confirm or reject this part of the poet's admirable description. His lines are these:

" Est lucos Silari circa, ilicibusque virentem
Plurimus Alburnum volitans, cui nomen Asilo
Romanum est, Oestron Graii vertere vocantes:
Asper, acerba sonans: quo tota exterrita sylvis
Diffugiunt armenta; furit mugitibus æther
Concussus, sylvæque et sicci ripa Tanagri."

Georg. lib. iii. v. 146—151.

TRANSLATION.

" About the Alburnian groves, with holly green,
Of winged insects mighty swarms are seen;
This flying plague, (to mark its quality,)
Oestros the Grecians call—Asylus we—
A fierce loud buzzing breeze;—their stings draw blood,
And drive the cattle gadding through the wood.
Seiz'd with unusual pains, they loudly cry:
Tanagris hastens thence, and leaves his channel dry.
This curse the jealous Juno did invent,
And first employ'd for Io's punishment:
To shun this ill, the cunning leach ordains
In sultry summer heats, for then it reigns,

"To feed the females ere the sun arise,
Or late at night, when stars adorn the skies."

DRYDEN.

The next notice of these animals in point of antiquity that we have yet observed is with the Veterinary writers of Constantinople, as *Absyrtus*, *Theomnestus*, &c. who appear to have designated them by the term *Teredines*, (τερηδινες,) perhaps on account of their cylindrical figure; or it may be from their boring, as they apprehended, holes in the stomach, an apprehension and belief which prevails very much at this day among the ignorant, but is without foundation. The impressions or indentations they occasion upon the soft internal coats of the stomach, are often, it is true, pretty deep, but never, as far as we have seen, have pierced through the stomach; these indentations probably close and fill up again, after the Bot is removed; for the death of animals is certainly not designed in their use.

The Veterinarians of Constantinople for their cure direct us to extract them from the fundament with the fingers, and then kill them by strewing hot ashes over them; by which recommendation it would appear that they entertained some obscure apprehensions of their afterwards coming to something hurtful, if permitted to live, though it is probable their notions were very obscure, if they had any, of their real transformations.

The same Veterinarians, I observe, have also made an allusion to the Bot which infests the head of the Stag; of which, excepting what Reaumur has informed us, we know no more at this day than what they did, at least that I am acquainted with. Reaumur describes it as existing in a sac of the Fauces. What the complete Insect is, we are as yet unacquainted; and I mention it here to excite the farther prosecution of this object, which to those who have leisure and opportunity, and

especially those situated near parks of deer, might find it an interesting pursuit. These early Byzantine Veterinarians imagined this Bot fell from the stomach into the head of the stag, whilst the animal was in the act of grazing.*

Aristotle is also conceived to have alluded to these Insects in the prefatory part of his history of animals, in the following passage:—"There are, moreover, animals which first live in water, afterwards, their form changed, they pass their lives out of it, as the WaterGnats, and after the same manner come the *Oestros*, which afterwards infest animals." Aristotle, it is probable, used this term in a general sense for all such animals of the fly kind as infest the Horse, without having in view this Genus, as constituted by modern naturalists.†

Our ancestors of these isles, at no very distant period, entertained notions as ill founded and vague as any the antients had ever conceived; for they supposed them somehow engendered of putrefaction and corruption, and that poverty and bad diet were favourable to their production. Blundeville wrote on Horses in the reign of Queen Elizabeth, and his words respecting them are these:—"And the third sort of worms be short and thick, like the end of a man's little finger, and therefore be called *Truncheons*, though they have divers shapes, according to the diversitie of the place perhaps where they breede, or else according to the figure of the putrified matter whereof they breede: yet they no doubt proceed all of one cause, that is to say, of *a rawe, grosse, phlegmaticke matter*, apt to putrefaction, engendered most commonly by fowle feeding," &c. Book III. chap. xcvi. p. 43.

Our great dramatist, Shakspeare, in the same manner, makes the ostler at Rochester, in the play of Henry the Fourth, say

* Editio Basiliæ, p. 142. Ibid. Latine reddita Ruellio, p. 55.

† Duval's Aristot. Lib. I. cap. i. Tom. II. p. 763.

thus :—" Peas and beans are as dank here as a dog, and that is the next way to give poor Jades the Bots :" a happy description of the popular notions respecting them of those days ; and the wretched nag of Petruchio, with his ill appearance and poverty, is in true character described as " so begnawn with the Bots."

Fearful apprehensions are entertained, even at this day, by the ignorant ; for if, by any chance, they are presented with the singular spectacle of the Horse's stomach having a cluster of Bots hanging to it, they are almost sure to enumerate it among the causes of his death, with expressions of horror, though amply accounted for by the actual destruction of some viscus, or other causes ; and seeing the coats of the stomach indented and impressed where they adhered, they let imagination carry them to the real perforation of the stomach, stating it as eaten up, and gnawed through by them.

Knowledge, which usually unfolds her treasures to the labours of the industrious and persevering, first dawned on this branch of science in Italy, about the commencement of the last century, when the discovery of the circulation of the blood gave a zest to the studies of Anatomy, and called up much laborious investigation of the structure of the bodies of animals ; and the formation of the Royal Society held out an encouragement and place of deposit for the labours of the inquisitive, and brought about a more close and correct notice and consideration of the various objects of nature.

Malpighi, as far as I yet know, was the first who undertook to describe them intelligibly, though very briefly, and only the Larva, in a paper or memoir laid before the Royal Society on a different subject.* The Larvæ he described were found in the stomach of an Ass, and were probably those of the *Oestrus*

* Malpighi Opera, De Structura Glandularum Epistola, p. 9.

Equi. He went no farther than describing their general appearance.

Redi next took a more extended and particular notice of them, giving some details of their history.*

At this early period of advancement in their knowledge crept in error, from a too loose and careless observation, and which was received and spread with its usual facility. Dr. Gaspari propagated a belief, that these flies, to get their larvæ into the bodies of animals, entered by the fundament, and there deposited their eggs; a thing that was utterly impossible, without their wings being mutilated or destroyed in the act: and the account, though perfectly fabulous, was but too easily believed, and even by such naturalists as Vallisneri, Reaumur, and Linneus himself, who says of the *Hæmorrhoidalis*, "*Habitat in Equorum intestino recto, miré per anum intrans.*" Syst. Nat. p. 970. These wonderful accounts, though erroneous, might serve one useful purpose, by exciting the public curiosity the more, and lead by this to a farther research into their true Habits and History.

The first who took much pains in considering them was Vallisneri, an Italian Physician of Padua, and the pupil of the celebrated Malpighi. With great industry, perseverance, and a care truly philosophic, he succeeded in exposing a large share of their natural history; he bred for the first time, atleast that we know of, the perfect Fly from the Grub, in the backs of oxen, and traced its transformations till it arrived at the winged state, though only one, and in a very mutilated state. His first Essay, however, was written upon the Bot of the Sheep, which inhabits the frontal and maxillary cavities of this animal. He accompanied his account with coarse figures of them, both of the Larvæ and perfect Insects. His Essay appears to

* Redi Francis Esperimenti intorni agl' Insetti, p. 170.

have been written about the year 1712. Subsequently, in the second volume of his Works, he gives some less accurate details of the Horse-bots. The accounts of this indefatigable writer are plentifully stored with Quotations from the Italian and Latin Poets, in the passages in which he apprehended allusion was made to these animals; and he unfortunately too implicitly gave credit to his friend and countryman, Dr. Gaspari, respecting their mode of propagation, which led others more readily to believe in the same delusion.*

The truly ingenious Reaumur, in France, was, in point of time, the next who studied the manners of these animals. He repeated nearly all the experiments of Vallisneri, giving farther details, and a better account of them, accompanied with more correct figures. He succeeded, though with much difficulty and labour, in obtaining two or three flies from the Maggot of the Ox-bot. His details, though somewhat prolix, are interesting; but his matter, however, is not kept separated from other objects, and we may observe that, if all the very numerous subjects of natural history were so treated, no ordinary time would suffice for the perusal of the volumes they would extend through.

Linneus has usefully exhibited an example of conciseness for these pursuits, which rebukes, as it were, the dilated details of several writers in natural history of this period. The actual fly of the Ox-bot has been truly rare, and difficult to obtain, and is seldom met with in Cabinets of Insects; and what is singular is, it remained unknown to Linneus to the last, for he described, through all the editions of the Systema Naturæ, the large Horse-bot with spotted wings, for it. I propose hereafter, when I treat of this species in particular, to give an account of a method I used for procuring this Fly, and that

* Vallisneri Opere Physico-Mediche, Venezia 1733, p. 217, et Vol. II. p. 1.

without much difficulty, by which any one may obtain it readily for his observations.

Reaumur, having pursued the Sheep-bot through its changes, obtained from his own coach-horses the Larvæ of the Hæmorrhoidal or Fundament Bot, and bred the Fly from it. He was successful also in raising to the Fly state, another and more rare species, the *Oe. Veterinus*, or *Red Bot-fly;* but, like Vallisneri, he was in doubt and perplexity whether they were varieties or the same species. His figures are better than Vallisneri's, which were hardly cognizable or characteristic enough to identify the species; being taken, perhaps, from mutilated specimens, or drawn without sufficient care, or from the difficulty of finding artists at this period. But what is most singular is, that neither of these celebrated naturalists appear to have known our common large Horse-bot, (Oe. Equi,) which made these writers much more difficult properly to understand; or if they knew it, they have at least not figured or described it.

In a subsequent volume, Tom. V. of this ingenious writer, (*Memoires sur les Insectes,*) he has given us an account of the Bot of the Stag, at least the Grub or Larva, for the Chrysalis or Fly he appears not to have known. He found these Larvæ in a sort of capsule or sac of the Fauces near the root of the tongue, and it is probable we may possess in our cabinets the perfect Insect of this Larva, which chance or accident may have thrown in our way, without knowing what it is, as it has never yet been bred through its different states, in order with certainty to identify it. Whether the Fauces or the large opening of the Eustachian Trumpet into the Fauces of these animals, is their proper habitation, we know not, or whether they crawled thither after death, from the sinuses of the face or any other parts, is uncertain. I have remarked, however, that those

Larvæ which infest the Horse's stomach never let go their hold, or move after the death of the animal, but are always found fixed to the coats of the stomach, that this apprehension of their moving after death is perhaps without real foundation.

To obtain certain information of this species, and procure the Fly, would not be an unpleasing task, or difficult to execute, by one having leisure and the opportunity of a park of deer for his observations. It would be only necessary for this purpose to keep a few of these animals for the two or three summer months, or through the months of June or July only, in a confined place, having a smooth floor, or one boarded or bricked, on which, by frequent search, the Larva fully grown, and falling from the nose or mouth, or perhaps the anus, would be easily discovered, and its advancement afterwards to the perfect or winged state would be attended with little or no trouble or difficulty. The Larva of this species, as figured by Reaumur, has considerable affinity to that of the Sheep, but is larger, and somewhat differently coloured. See Tom. V. p. 67, Pl. 9, fig. 2, 6. I mention this the more particularly to draw the attention of others to it.

The next who has given us any account of these Insects worth noticing is Baron De Geer, an Envoy or Ambassador, we believe him to have been, from the French Court to the Court of Sweeden. He was eminently skilled in the natural history of Insects, and was the intimate friend of Linneus. He described the true Ox-bot, and *the large Horse-bot*, and was aware of the Linnean error in respect to these two Insects, which it is singular Linneus did not avail himself of, but, like an original writer, he perhaps perused but little those that followed him. De Geer, however, not having perhaps ever seen the *Hæmorrhoidalis*, confounded it with the Ox-bot, from the similarity of its description. His figures are but indifferent, and very inferior to those of Reaumur; nor has he much more than

copied the remarks of Reaumur in respect to their history. He has called the great Horse-bot *Oestrus Intestinalis*, a name we cannot acquiesce in, as this species truly lives in the stomach, and merely passes through the intestines in its way to the ground to become a Chrysalis.

The next writer on this subject was Linnæus himself, whose acuteness, taste, and indefatigable research, the admirers of natural history will long have cause gratefully to remember. He furnished us with some interesting details respecting the Rhein-deer Bot, acquired during his tour in Lapland, and he marshalled, for the first time, the members of this singular family, under the generic title *Oestrus*, separating them from the other families of flies, hostile to the repose of animals. He enumerated five species, all European, as follows :—*Oes. Bovis*, intending to give the Ox-bot, but described by mistake the large Horse-bot, with spotted wings for it. The *Oe. Tarandi*, or *Rhein-deer Bot*. The *Hemorrhoidalis*, or *Red-tailed Horse-bot*. *The Nasalis*, for so he termed the next species, from supposing that it entered and lived in the larva state in the fauces or nostrils of the Horse, which, as it now appears to be erroneous, we have ventured to set aside the name, and to call it the *Veterinus*, as the former name if preserved would ever convey a false notion of its habits. The name Veterinus signifying of or belonging to beasts of burden, and not implying any precise place in respect to its habitation, we think better suited to it, at least it may continue till its history is completely made out. Wanton change in names cannot be too much reprobated ; but when a strong necessity, from actual research and discovery, makes it necessary, it becomes a duty ; as specific names are intended as aids, but not immoveable fetters, to natural history.

His fifth species was the *Oestrus Ovis*, or Sheep-bot. The number has since been more than doubled by succeeding writers.

After Linnæus followed a considerable number of detached notices of these Insects, by various writers of France, Germany, and Sweden, without adding much to our knowledge of them; as Geoffroy, Wohlfarht, Fischer, Leske, Ross, Villers, Sultzer, Frisch, Modeer, &c.

An entomologist of great eminence, J. C. Fabricius, of Kiel, in Holstein, is the next we have to notice as a writer on this subject. He was a pupil of Linnæus, and indefatigable in describing and adding to the enumerations of his great master, the Insects which the numerous collections and cabinets of Europe afforded, and by which he has vastly increased the numbers described by his predecessor, and his descriptions and nomenclature are often truly excellent. In his last work the *Systema Entomologia Emendata*, he has, however, obscured this genus in a way that it will not be easy to unravel. He has given an *Oestrus Bovis*, with a description nearly corresponding to the true one, *alis immaculatis*, &c. but immediately refers to the Linnean Bovis *alis maculatis*, and continues the Linnean references.

Under the title of *Equi*, he has described the *Oe. Veterinus*, under which the Hæmorrhoidalis is introduced as a variety β; so that a description of our common *Oe. Equi*, is altogether omitted as a species, at the same time the variety of it, β, of my account, and of the Linnean *Fauna Suecica*, is presented as a distinct species, under the strange title of *Oe. Vituli*, as though calves were subject to them; and beneath it again is a reference to the true *Equi* of Geoffroy.

The commission of errors like these, in a genus whose species had been more numerous, might have defied the possibility of detection, whilst the patient investigator might endeavour to understand them with unavailing labour. Nor can I observe without regret, in this respectable work, such a direct abuse of the intention of synonyma, which far from assisting as auxiliaries

to the description which they ought to do, serve only to perplex by their perfect disagreement. His generic characters of this genus are also false, as though made by guess more than examination.

It has been doubted whether these animals possess any mouth: Linnæus expressly says, "*Os nullum punctis tribus;*" but when the hairs are removed, which in every species very much obscure the parts of the mouth, two clavated *palpi* are seen, and between them the opening of the mouth; and by laying open the vesicular or inflated part of the face, the continuation of it is visible in the form of a membraneous *haustellum*, which is generally coloured with some dark brown matter lodging on the inside; though I confess, after repeated dissections, I have not been able to trace this *haustellum* farther than the inside of the inflated part of the head, where it appears to enlarge and terminate.

Fabricius has minutely described *labia* to the *haustellum*, and other apparatus to the mouth, which I have not been fortunate in obtaining a sight of. At the same time I cannot help being surprized that he should have overlooked the *palpi*, which he expressly denies the existence of, though tolerably visible even without the aid of glasses.*

He added also to his enumeration the *Oe. Trompe* and the *Oe. Pecorum*, and one or two of the American species of Bots, or rather subtercutaneous flies, which on more minute inspection we are induced to separate from this genus, and form them into a new family, under the generic title *Cuterebra*, three species of which we propose to give, for the first time with figures.

After Fabricius, Professor Gmelin published an enlarged edition of the *Systema Naturæ*, and collating from all quarters, vastly enlarged in appearance the extent of this family; but unfortu-

* Fabricii Genera Insectorum.

nately copying from books, without any knowledge of the animals themselves, he fell into numerous errors. Three species he added to the enumeration of Fabricius, from the works of Pallas, viz. *Oe. Antelopæ*, *Fasciculosus*, and *Hominis*, which there is much reason to believe from his descriptions are all false; and instead of placing the *Equi* in the name of Bovis, as his excellent original had done, we find the *hæmorrhoidalis;* and by placing the *Equi* again in the name of *hæmorrhoidalis*, and mixing the references to each, an almost inextricable labyrinth of confusion is the consequence, while the true *Bovis* still escapes undescribed, unless as being the same as *hæmorrhoidalis*.

The mistake of *hæmorrhoidalis* for *Bovis* arose probably from their similarity in description, in which they certainly interfere very much; though no two species can be more distinct when seen together than these. This will ever be the bane of mere compilation in natural history.

In continuing to the present time this brief view of their history, or the detection of their habits, I am necessarily led to notice a memoir or essay of my own, formerly transmitted to the Linnean Society, and published in the 3d volume of their Transactions, p. 289, of which I consider this present work as only a more digested and extended account. This was in the year 1796, or about nineteen years ago; and which memoir, as it adds a few new discoveries respecting them, concludes this historical view of the developement of their habits.

We are led to apprehend, that this family may be usefully divided into three sections or subdivisions, according to the different parts or situations in the body the Larvæ inhabit, viz. the *Gastricolæ*, or those which inhabit the stomachs of animals. It

separates those of the Horse from all the other species. The next division will be the *Cuticolæ*, or those which live in their Larva state beneath the skins of animals ; and the third the *Cavicolæ*, or those living in the cavities of the face. Perhaps a fourth division might be constituted, including those of the *Fauces*, if the accounts we at present entertain of them be true, and the nerves of the wings of these different families appear also to afford characters for these divisions, which was first observed to me by my friend Dr. Leach.

The *large Horse-bot* being the most interesting to us in this country, I shall begin my account with that species, and follow it with the other species of that division.

Of the Oestrus Equi, *or Large spotted winged Horse-bot.*

As it is necessary to break into the circle of its history at some point, I shall begin with an account of the egg, and its deposition upon the skin of the legs of the horse, which is done in the following remarkable manner :—When the female has been impregnated, and the eggs sufficiently matured, she seeks among the horses a subject for her purpose, and approaching him on the wing, she carries her body nearly upright in the air, and her tail, which is lengthened for the purpose, curved inwards and upwards : in this way she approaches the part where she designs to deposit the egg ; and suspending herself for a few seconds before it, suddenly darts upon it, and leaves the egg adhering to the hair : she hardly appears to settle, but merely touches the hair with the egg held out on the projected point of the abdomen. The egg is made to adhere by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and, poising herself before the part, deposits it in the same way. The liquor dries, and the egg be-

comes firmly glued to the hair: this is repeated by these flies till four or five hundred eggs are sometimes placed on one horse.

The skin of the horse is usually thrown into a tremulous motion on the touch of this insect, which merely arises from the very great irritability of the skin and cutaneous muscles at this season of the year, occasioned by the heat and continual teasing of the flies, till at length these muscles appear to act involuntarily on the slightest touch of any body whatever. See Pl. I. fig. 1.

The inside of the knee is the part on which these flies are most fond of depositing their eggs, and next to this on the side and back part of the shoulder, and less frequently on the extreme ends of the hairs of the mane. But it is a fact worthy of attention, that the fly does not place them promiscuously about the body, but constantly on those parts which are most liable to be licked with the tongue; and the *ova*, therefore, are always scrupulously placed within its reach. Whether this be an act of reason or of instinct, it is certainly a very remarkable one. I should suspect, with Dr. Darwin,* it cannot be the latter, as that ought to direct the performance of any act in one way only. Whichever of these it may be, it is, without doubt, one of the strongest examples of pure instinct, or of the most circuitous reasoning any insect is capable of.

The horses, when they become used to this fly, and find it does them no injury, as the *Tabani* and *Canopes*, by sucking their blood, hardly regard it, and do not appear at all aware of its insidious object. During warm sunny weather this process is seen performed on commons, and in the fields.

The eggs thus deposited, (see fig. 2, and when magnified fig. 3,) I at first supposed were loosened from the hairs by the moisture of the tongue, aided by its roughness, and were conveyed to the stomach, where they were hatched: but on more minute search

* Zoonomia. *Vid.* Chapter on Instinct.

I do not find this to be the case, or at least only by accident; for when they have remained on the hairs four or five days they become ripe, after which time the slightest application of warmth and moisture is sufficient to bring forth in an instant the latent *larva*. At this time, if the tongue of the horse touches the egg, its *operculum* is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach. If the egg itself be taken up by accident, it may pass on to the intestinal canal before it hatches; in which case its existence to the full growth is more precarious, and certainly not so agreeable, as it is exposed to the bitterness of the bile. I have often had proof of this by making the following experiment with the eggs.

With a pair of scissars I clipped off some hairs with the eggs on them from the horse, and on placing them in the hand, moistened with saliva, they have hatched in a few seconds. At other times, when not perfectly ripe, the Larva would not appear, though held in the hand under the same circumstances for several hours; a sufficient proof that the eggs themselves are not conveyed to the stomach. See fig. 4.

It is worthy of remark, that it is probable the greater part of the *ova* deposited by this fly, are taken up in consequence of the irritations of other flies, as the *Canopes*, *Tabani*, and *Muscæ*, who, by perpetually settling on the skin, occasion a horse to lick himself in those parts, and thus receive the *larvæ* on the tongue and lips; and a horse that has had no *ova* deposited on him, may yet have the Bots, by performing the friendly office of licking another horse that has. The eggs on the shoulder are particularly well disposed for being received in this way.

It is fortunate for the animals infested by these Insects, or rather most beautifully ordained, that their numbers are much reduced, and kept within due limits, by the hazards they are exposed to in the singular round of their propagation. I should

suspect near an hundred at least are lost for one that arrives at the perfect state of a fly. In the first place, in the depositing the eggs not a little interruption is given to the female by the movements of the Horse: the eggs when deposited may remain on the hairs untouched by the animal, unless some casualty makes him lick those parts to which they adhere, and when ripe, or if hatched and opened by rain, or other moisture, the larvæ may come forth, and crawl about till they die.

In the mouth of the animal they have the dreadful ordeal of the teeth and mastication to pass through. On their arrival at the stomach, they may pass, mixed with the mass of food, into the intestines; and, when full grown, on dropping from the *anus* to the ground, a dirty road or water may receive them. If on the commons, they are in danger of being crushed to death, or of being picked up by the birds, who so frequently for food attend the footsteps of the cattle. By such contingencies as these, Providence has wisely prevented their too great increase, and the total destruction of the animals they feed on.

The egg is glued on the hair with the broad end downward, (see fig. 2, 3,) and is thus well disposed for the operation of the tongue in removing the operculum. This operculum is of an oval figure, surrounded with a prominent margin. The microscope shews the case of the egg to be shagreened in squares, or divided by lines longitudinally and transversely disposed.

Of the Larva or Grub of the OESTRUS EQUI, *or spotted Horse Bot.*

At its first hatching it is, as we have observed, a small active worm, long in proportion to its thickness, but as its growth advances, it becomes proportionably thicker and broader, and beset with bristles.

Some of these Larvæ, when about two-thirds grown, are represented in Plate I. fig. 5, adhering to the stomach. They are

very frequent in horses that have been at grass, and are in general found adhering to the white insensible tissue or coat of the stomach which comes from the lining of the œsophagus, and which in extending or leading over the upper part of the stomach, represents, or is similar to, the maw or first stomach of the ruminating animals. I do not recollect ever seeing many situated on the red membranes of the stomach, which are, without doubt, more sensible, and where their effects would have been more disagreeably felt.

They make small deep round holes where they adhere to this white tissue, and sometimes so deep as to pass through it but not through the other layers or coats of the stomach, as has been often hastily apprehended and asserted, that they are probably but little felt by the animal. In proof of this, I once gave six, and afterwards twenty-seven, of the full grown Larvæ to a horse, wrapt up in balls of meal, but the horse by no external indications showed any uneasiness in consequence.

They usually hang in dense clusters to this white cuticular lining of the stomach, and maintain their hold by means of two dark brown hooks, (see fig. 10, Plate I.) between which a longitudinal slit or fissure is seen, which is the mouth of the Larva. When removed from the stomach by the fingers by a sudden jerk, so as not to injure them, they will, if fresh and healthy, attach themselves to any loose membrane, and even to the skin of the hand. For this purpose they sheath or draw back the hooks almost entirely within the skin, till the two points come close to each other; they then present them to the membrane, and keeping them parallel till it is pierced through, they expand them in a lateral direction, and afterwards, by bringing the points downwards towards themselves, they include a sufficient piece of the membrane, to remain firmly fixed for any length of time as at anchor, without requiring any further exertion.

These hooks, the better to adapt them to this purpose, appear

to have a joint near their base. The Larvæ of *Œ. Hæmorrhoidalis* and *Ovis*, and probably all those which feed on the mucous membranes lining the internal canals of the body, are also furnished with these *tentacula;* whilst those Larvæ which inhabit beneath the skins of various animals will be found universally without them, being confined in the capsule of the skin sufficiently secure.

The body of this Larva (see fig. 6, Plate I.) is of a whitish red colour, and appears to be composed of eleven segments, surrounded with a double row of horny bristles, a longer and a shorter series, and placed alternately. The two last segments appear naked, or destitute of them. These spines are of a reddish colour, except the points, which are black, and are directed towards the tail or large end of the Larva; they are longer below or on the belly of the Larva, than above or on the back, but are still longer at the sides. By means of these they probably regain their situation, if at any time they are detached from their hold, by forcing them against the surrounding membranes, and are assisted by the two crotchets or hooks at the head. I once met with some of these in the duodenum, close to the pylorus, having been carried perhaps into the intestines by some casualty, and could not again regain completely their situation in the stomach.

The aperture of the mouth appears surrounded with a prominent margin, and is irregular and harder than the rest of the skin; but whether hard enough to masticate and feed on the vegetable matters in the stomach, may be a question. Their food is most probably the chyle, or, as it is in this state by some modern anatomists termed chyme, or an imperfect sort of chyle, which being nearly pure aliment, it is probable affords but little excrementitious residue. That it is the gastric chyle and not the vegetable matter that they feed upon, is also rendered probable from the support of the other species of this genus on purely animal secretions.

At figure 11 is seen a convoluted tube, which, in dissecting one of these, once presented itself to me, and which I apprehended was the alimentary canal or intestine of the Larva.

On opening the body of the Bot, and removing the gelatinous matter, the air tubes are seen, of a splendid silvery colour, or as though injected with pure quicksilver. Their appearance is singularly beautiful, especially if the Bot be alive, or recently dead; and it was in reality what first attracted my attention to these objects, for if dead, and kept some time, these tubes become dull, and of a brown colour. This glittering appearance arises from the air being seen through the semitransparent pearly refracting coats of the vessel. They remain distended by their own inherent elasticity, and are filled with air to their minutest ramifications. These branches often run up and down in the gelatinous matter, in directions nearly parallel to the principal trunk.—See fig. 11.

These tracheæ or air pipes are eight in number in this Larva, and their disposition is endeavoured to be represented at fig. 7. The two smaller ones, exterior to the central circle of larger ones, appear to communicate with two small prominent nipples or points upon the first segment, which are seen in fig. 10.

These tracheæ or air tubes open into one common reservoir, at the large end of the Larva, beneath a singular plate, fig. 9, of a cartilaginous or horny consistence, having six semicircular lines, with their points curved and opposed to each other; these lines are also made up of alternate depressed and elevated spots of black and white; and at this blunt extremity are also seen two protuberant lips or sacs, filled with a watery fluid, which meet and serve to close over and cover up this horny plate.—See fig. 8.

Through this plate the air is perhaps admitted into these tubes, the branches of which appear to terminate in the skin, the gelatinous matter, and upon the viscera. In most Larvæ of the fly

kind, or of the dipterous order of insects, there are two distinct plates at this obtuse end, as may be seen in the common maggot of the house fly and the blow fly. Keller, however, supposes, and it is generally apprehended, and perhaps truly, that the air is not received at this large end, but at the extremities or terminations of these branches in the skin, forming on the sides, what are called the *spiracula*.

The lips at the obtuse end of the Bot seem designed to conceal and cover this horny plate, and defend it from the liquors of the stomach, or clean and clear it of these gastric fluids or other matters when necessary. In the Larva of the Œs. Ovis, or Sheep Bot, this respiratory plate is not covered with lips in this way, but is surrounded by a prominent margin or extension of the skin, which closes over the plate, at the will of the animal, and on opening again suddenly, is often attended with a distinct snap, that may be heard to some distance. These lips as we have stated appear to be mere membranous bags, and filled with lymph only, which renders it probable that they are solely for the convenience of the Larva, and form no part in the future Insect, as are probably nearly or quite all the parts connected with the skin.

Respiration appears to be the office of these air canals, which are the lungs of the Larva ; and, considered in this point of view, they are much larger than the respiratory organs of any other animal : which is the more extraordinary, if the purpose of respiration in animals be the production of animal heat, as the later chemists suppose, this being altogether unnecessary to Larvæ that are supplied so abundantly with it from the high temperature of their residence in the living stomach ; nor can these organs be formed for the purposes of the future insect, since they cannot be detected in either the Chrysalis or Fly. The permeability of these respiratory vessels to oxygen gas, is also to be taken into the account. They would appear to be in these animals stouter

and less permeable than are the cells of the lungs formed of a thinner membrane.

I have since found that air vessels of a similar structure may be detected in the Larvæ of most insects, as well in those that are not exposed to any extraordinary temperature as those that are; they are, therefore, not constructed with any view to these singular situations.

From the superior magnitude of the respiratory organs in most of the Larvæ of insects, one should be almost led to imagine that the respiration in all animals was more intimately connected with the reception of food, and the converting it into living matter, than any other design.

In corroboration of this we may observe, that while the respiratory organs are so large in the Larvæ, they are remarkably small in the perfect insect, which also, in general, has occasion for very little food.

Perhaps the superior size of the air vessels of the Bot, compared with the Larvæ of other insects, arises from the greater rarefaction and impurity of the air it is exposed to in the stomach, which may render a larger portion of it necessary.

Whilst upon this subject it may not be improper to notice the air vessels of the Larva of the *Musca pendula*, which are constructed in a very different way from any others I have seen. The two principal trunks in this Larva are made up of semicircular cartilaginous rings or fibres, which are disposed in a spiral direction, so as to form the tube. It is evident by this structure, that the area of the tube may be entirely obliterated, and the sides be brought into contact.

The convenience attending this structure, to a Larva living in putrid fluids of considerable depth, appears to be, that beside its use in respiration, it may serve the same office as the air bladder in fishes, regulating by its contraction or expansion the den-

sity or rarity of the included air, and consequently the descent or ascent of the Larva in those fluids.

These Bots, as is also the case with two or three other species, pass the autumn, winter, and spring months in the stomach, and arrive about the commencement or middle of the summer at their full growth, requiring a twelvemonth fully to complete their structure. The slowness of their growth and the purity of their food must occasion what they receive in a given time to be proportionably small; from whence probably arises the extreme difficulty there is found in destroying them by any medicine or poison thrown into the stomach. After opium had been administered to a horse labouring under a case of locked jaw for a week, in doses of one ounce every day, on the death of the animal I have found the Bots in the stomach perfectly alive. Tobacco has been employed in much larger quantities in the same complaint, and has been also longer continued without destroying them. They are also but rarely affected by the drastic purgatives which bring away in abundance the *Teniæ* and *Ascarides*.

It is to be remarked, these Larvæ probably never change the skin, which is very dense and tough, and becomes at last the shell of the Chrysalis; and we may therefore discover upon the Chrysalis all the points and lineaments of the Larva dried up and diminished, in most other insects a cuticle separates from the skin at the time of this change. The small end of the Chrysalis, in all the species of this genus, contains the head of the Fly, the contrary being the case with almost all other insects.

This species, though common with us in England in the Fly state, in the Chrysalis state is rare and difficult to procure; and for this reason, that the Larva when full fed and grown to its size, escapes from the stomach and through the intestines, without making any stay or lodgment at the fundament, as the next species does, which affords us the more easy opportunity of pro-

curing it. The specimens which I have obtained of its Chrysalis have been found upon the ground, or under horse dung; its appearance is given Pl. I. fig. 12.

It is fortunate for the animal, or rather we should say it is beautifully ordered and provided, that the Larva of this species should make no stay at the edge of the anus, as far at least as we have yet observed, and as is the case with the next species; for it is obvious, had it so done, its roughness and more considerable dimensions would have rendered it a very serious evil.

Whether these Larvæ can exist in the stomach of a carnivorous animal I am not certain. I gave upwards of a hundred eggs (proved by trial to be ripe, and containing a living caterpillar,) to a cat in milk at various times; and on destroying her at the end of two months after the first portion had been given, no traces of them in the stomach or intestines could be discovered.

I have once seen the Larva of this Oestrus in the stomach of an ass: indeed there is little reason to doubt their existence in the stomachs of all this tribe of animals.

The Larva, when matured and ripe, quits the stomach of the animal, and falls to the ground, and finding a convenient place of retreat, undergoes its change to Chrysalis, the skin then losing its organization, and changing its colour to a reddish brown. After remaining torpid in the state of Chrysalis a few weeks, the superfluous moisture being removed, and the parts of the future Insect being hardened by drying, it bursts from its confinement, and the Fly appears making its exit at the small end, (see fig. 13 and 14, the male and female,) and the head or face of the Fly very much enlarged, fig. 15, and one of its wings magnified, showing the distribution of its tendons or nerves, fig. 16.

On quitting their shell they in a few hours become dry, take wing, and then seek their mates. The female being impregnated, searches for a proper subject among the Horses, performs

with great solicitude and care her office of depositing the eggs on the legs of the Horse, in the manner we have already stated; thus completing the wonderful round of its operations and history, which sometimes I have thought might not afford a subject altogether unworthy of the poet's pen, being novel, innocent, and full of singular incident; and if mingled with the probable designs of an all-wise Providence in thus providing for them, and their probable benefits to the animal in return for their habitation, and a description of the dangers and solicitudes attending the process of their birth and breeding: the rural scenery of the places of their resort, and of these exploits, and with useful reflections arising from such incidents, it might be rendered perhaps, in good hands, not destitute of interest and amusement.

There is considerable difference in the male and female Fly; the extremity of the abdomen in the one is obtusely abbreviated, in the other drawn out to a style or horny tube of some length, for the more convenient depositing the eggs and applying them to the hair.—See fig. 1. Pl. I.

The perfect Fly but ill sustains the changes of weather; and cold and moisture, to any considerable degree, would probably be fatal to it. It is remarkable these flies never pursue the horse into the water. This aversion I imagine arises from the chilness of that element, which is probably felt more exquisitely by them, from the high temperature they had been exposed to during their Larva state in the body of the animal. The heat of the stomach of the horse is much greater than that of the warmest climate, being about 102 degrees of Fahrenheit, and in their fly state they are only exposed to 60, and from that to about 80 degrees. This change, if suddenly applied, would, in all probability, be fatal to them; but they are prepared for it, by suffering its first effects in the quiescent and less sensible state of a Chrysalis. I have often seen this Fly during the night-time, and in cold weather, fold itself up, with the head and tail nearly in contact,

and lying apparently in a torpid state, though in the middle of summer.

To prevent unnecessary repetition, these Flies are described with the other species, both in English and Latin, at the conclusion of this Essay.

On the Oestrus Hæmorrhoidalis, *or Fundament Bot.*

I shall begin my account of this species at the same point as the former, with the deposition of the egg, the manner of which, I apprehend, has never been described or known before.

This proceeding I have frequently witnessed, and it may be seen by any one desirous of observing so curious a fact upon most of the commons of this country. About Ditton, Molesey, and Esher, I have more particularly seen it where the cattle are much annoyed with it; and I once also saw this same operation in the fertile meadows of Holland, near to Groningen, while being conducted a prisoner through this country to Amsterdam, and I have caught the Fly more than once in the very act in my hands.—See fig. 17. Pl. I.

The part chosen by this Insect for this purpose is the lips of the Horse, which is very distressing to the animal from the excessive titillation it occasions; for he immediately after rubs his mouth against the ground, his fore-legs, or sometimes against a tree, with great emotion; till the animal at length finding this mode of defence insufficient, enraged he quits the spot, and endeavours to avoid it by galloping away to a distant part of the field; and if the Fly still continues to follow and tease him, his last resource is in the water, where the Oestrus never is observed to pursue him. These flies appear sometimes to hide themselves in the grass; and as the horse stoops to graze they dart on the mouth or lips, and are always observed to poise themselves dur-

ing a few seconds in the air, while the egg is preparing on the extended point of the abdomen.

When several of these flies are confined in a close place, they have a particularly strong musty smell; and I have observed both sheep and horses, when teased by them, to look into the grass and smell to it very anxiously; and if they by these means discover the Fly, they immediately turn aside and hasten to a distant part of the field.

I once saw in a meadow or field upon the cliffs at Margate, a Fly of this sort teasing a Horse that was confined to a small space by a spike stuck in the ground, to which a cord was tied. He could not get away from its attack, and became quite furious, for in kicking at the Fly with his fore-foot, which he did vehemently, he often struck the bone of the lower jaw, creating excessive pain; for in that direction while grazing the Fly comes to the beard of the lower lip.

The eggs of this species are difficult to be seen upon the Horse's skin or beard, owing to the agitation of the beast, and from the colour of the egg being dark like that of the skin of the Horse. The animal has been generally too impatient, while undergoing this operation, for to let me examine them very well. I ascertained, however, its form by pressing one of these eggs from the abdomen, which had somewhat the appearance and figure represented at 18, having a kind of *petiolus* or stalk to it, and its blunt extremity obliquely truncated and curved.

The Larva or grub of this species inhabits the stomach as the former, generally adhering to the white lining, and is disposed promiscuously in dense clusters, after the same manner; they may however be distinguished from them by being in general smaller, longer in proportion to their bulk, and rounder; and I have thought of a duller red, or more inclining to white, than those of the Equi, for they differ in appearance in different subjects.

This species was more particularly known to Reaumur and Vallisneri, and is the same about which Gaspari was led to propagate his wonderful accounts of the Fly actually entering the body of the animal to deposit its eggs, a thing on several accounts impossible; for, in the first place, it is to be remarked, that no animal of this description is so unwise as to commit an act of severe and deliberate punishment upon itself, and of self-destruction, for all its members must have been broken by passing the strong sphincter of the Horse's rectum; or if the rectum was first protruded, and, as they pretended, entering at this moment, he became enclosed among its folds, he would be so unfavourably situated, being surrounded with slime, wetted, and compressed by the intestine and its contents, he could not certainly perform with the requisite deliberation this important act: but the anus is in fact closed, rather than opened, by any irritation externally applied. The Fly would be crushed in attempting to pass the sphincter of a horse's rectum; and having no means of holding while depositing its eggs, it would be quickly evacuated with the dung; and it is evident that the whole of the *ova*, to the amount of two or three hundred, must be deposited in one horse, as it is impossible, if the Fly survived, that it could undergo this punishment a second time, for the heat and moisture of the rectum would at least destroy its wings, and prevent it from attaining this situation.

I mention these objections, not as merely relating to this species, but that it may not be credited of the *Œ. Nasalis*, or indeed of any of them, that they really enter the body of the animal to obtain for their young a situation there.*

* The fly Dr. Gaspari saw was without doubt the *Hippobosca Equina*, or Forest Fly from the circumstance of its getting beneath the tail, which this Fly often does, and all the rest of the account was added from imagination. That a fly might deposit its eggs on the verge of the anus, is not impossible; but we know of no example or instance of it at present.

On dissection this Larva is found to possess similar air tubes and alimentary canal. When it is ripe, and has passed through the intestines, its skin becomes of a greenish-red hue. It generally assumes the Chrysalis state in about two days after leaving the rectum, and is then of a deep-red colour.—See fig. 19.

The Larva of this species may be obtained from almost any Horse that has been much the preceding year at grass, and exposed to these Flies, and will be found during the summer months sticking more or less within the verge or opening of the anus, adhering to its soft lining, and producing considerable irritation and uneasiness. Indeed I once well remember being on a tour of pleasure in the Isle of Wight, and experiencing much annoyance from these larvæ. The little Horse I had hired for the journey became so lazy and unwilling to go on, and moved so awkwardly, that I could not keep pace with my company, and I was at a loss how to proceed ; but on casually taking up the tail, I discovered three or four of these Insects hanging to the rectum, and their removal instantly proved a cure.*

When they are taken away from these parts with a view of obtaining the Fly from them, it should be done with care, and by a light sudden twitch or jerk of the fingers, not compressing them ; for if squeezed much in this tender state, (for all Insects are very much so when about to change to Chrysalis,) the Fly is damaged, if not killed : in which case, though they undergo their change to the Chrysalis, it never hatches.

From the beginning of June to the end of July or August, they are found hanging in this way to the end of the rectum, as though reluctant to leave their warm habitation. They appear never to change their skin during their growth, as many other

* Vegetius observes, *Cossi et lumbrici quâ curâ tollantur ad manum.* Diligenter tentabis et invenies vermes collectos exisse in singulis locis et intestinum pertundere ex qua necessitate nascitur dolor periculosus. Digitis evelle eos qui quidem vix evelluntur et ipsa tibi in manu cohærent, ut difficile eos projicias. Lib. I. cap. 52.

Larvæ ; if they did, it is probable they would lose their hold, as the hooks are principally connected with the skin, and separate with it by maceration, leaving an indentation where they were lodged.

These Larvæ have the power, when compressed or squeezed, of contracting and hardening themselves, and it is probable they in this way resist the violent pressure they must occasionally sustain, from the weight of the food and the actions of the stomach, and in passing through the intestines and the *sphincter ani*.

After remaining in the chrysalis state about two months, the Fly appears.—See fig. 12 and 13,—the male and female,—and their description in the sequel of the paper.

This species may still retain the name of Hæmorrhoidalis, without any impropriety, not from the supposed history of its entering the anus, but from the termination of the abdomen being red, Linnæus having generally chosen to distinguish the insects so marked by that name ; also from their resembling the hæmorrhoids or piles, while hanging to the extremity of the rectum.

The learned Charlton, (Onomasticon Zoicon, p. 56,) and afterwards Dr. Johnson, (see Dictionary,) have considered ascarides as the synonymous term among the ancients for the Bots : that term has ever been applied to the thin smooth worms of the intestines, but, I apprehend, never to these.

On the Oestrus Veterinus, *or Red Bot.*

The mode of this insect depositing its eggs or nits, is at present unknown. By watching for them on the commons in the warm days of the sixth and seventh month, (or July and August,) it might be detected, I apprehend, without very great difficulty. They perhaps deposit them about the lips or legs, as the former species. The Larva of this species is also not certainly known.

That it inhabits the stomach as the two former species there is little doubt ; and I have taken considerable pains to search for it at the slaughter-houses, and have found a species in the stomach which widely differs from the Equi and Hæmorrhoidalis, and which I presume may be the Larva of this. I have given a figure of it at Pl. I. fig. 24 ; though it is possible there may be a fourth species inhabiting the stomach of the Horse, in which case it may be still doubtful, that I do not positively assert it to be this Larva belonging to the Veterinus.

This Larva, if it is the Veterinus, may be known from the two preceding species, being smaller, of a more tapering or oblong figure, and the segments more detached and rounded, shining, smooth, and of a pellucid red or ruby colour, more particularly at the tail or obtuse end. Although its coat appears smooth to the naked eye, the microscope detects small spines or points in double rows, the two lines alternating ; and these points occur less frequently in approaching the large end, the two last segments being destitute of them. In its very young state there appears to be but a single row of these points, the second row, or that nearest to the middle of the segment being wanting. Two short vesicular palpi appear at the very extremity of the large end, situated upon the lips which cover the air plate.

Through the thin transparent skin of this Larva when very young may be seen the beautiful silvery tubes of respiration, with their numerous ramifications, diverging, closing, bending, and playing among the soft matters within, and accommodating themselves to every movement of the animal.

I have also seen, as I apprehend, another species in the stomach, which I take to be different to any of the before enumerated species, and which is much whiter than the three preceding, being almost perfectly white. I found them forming a cluster in the stomach of a Horse early in the sixth month, or June, and therefore presume they were near their full growth ; their whiteness

was opake or milky, with hardly any redness about them, though the last segment was somewhat faintly tinged with red. But there appears in the spines or bristles a peculiarly distinctive character, for they are in a single row only, and regularly placed in a line, and the microscope could hardly discover that their points were black, being minutely so, and hardly visible to the naked eye, while the other species were distinctly so to some distance, in make and other circumstances they resembled the Equi, but were not above half their size. Having stated these circumstances, I leave the further investigation of them to the curious.

The real Chrysalis of Veterinus I once found in the neighbourhood of Worcester, in a meadow below Perry Wood, between it and the city, under some horse dung; and the figure of it was, as near as I can remember, for I threw it away after the Fly came out, much like figure 26, which is done from memory, for at that time I had no prospect of ever having to write on these subjects.

This Fly, after it left the Chrysalis, being confined under a glass in my window, became, if I remember right, singularly active and impatient, and destroyed in its rage one of its wings, drawing it towards its mouth with its legs, and devouring it, as it appeared, and whirling round with considerable velocity and noise upon its back. Whether other flies so confined would do the same I know not.

I think Reaumur's figures I have referred to are certainly meant for this species, but the figures 1 and 2 are evidently two different Chrysalides, though given for the same. The one is of Hæmorrhoidalis or Equi, the other smoother, and probably of this species. Tom. IV. pl. 35. The Larva of this species is not given by him at all, but in the preceding plate there is a good figure of the Larva of the Hæmorrhoidalis, which he considered the same, and the Flies 9 and 10 are the Hæmorrhoidalis, though badly executed. As far as I remember, the Fly of Veterinus, in making

its way out of the case of the Chrysalis, broke away the three or four last segments of the small end, leaving a ragged edge to the opening, but not a regular marginated operculum as given in Reaumur's figure, and which operculum is so remarkable in the Chrysalis of the Oestrus Bovis.

This Insect proved a male, fig. 26; and I afterwards in the cabinet of Linnæus, obligingly presented to my observation by Sir James Edward Smith, found the female, fig. 27, with a short stylus to the abdomen. Some other specimens of this species were found in this cabinet, taken from the collection of Hudson, the ingenious author of the Flora Anglica, nearly spoiled, and entangled in the melted wax with which his drawers were covered, as was the custom of those days before the use of cork. A miserable fire consumed his house, and nearly his Herbarium, and occasioned the melting of the wax before mentioned.

Linnæus supposed this Insect entered by the nostrils and lived there as the other did by the fundament; but as no insect would destroy its own wings, and so miserably punish itself, we have ventured to obliterate the name, that erroneous notions should not be suggested by it.—For its description see the conclusion of this dissertation.

It appears to me that more certain information might be obtained respecting this and the other species that infest the domestic animals, by a very simple method, and which I propose next year to endeavour to prosecute, if my health and present views remain. For this end I propose to procure from the slaughter-houses, and the stomachs of dead horses there, such of these obscure species in the Larva state as it may be desirable to investigate; and since they cannot be fed with any prospect of success out of the body, I intend to inclose them in a ball of meal, and administer them to my own horse, as balls of physic are administered, and in his stomach they will perfect their growth. I next intend to have a stall boarded at bottom and closely jointed, with

a margin round to prevent the escape of the Larva on its falling from the intestines; or indeed, and which would be better, a small apartment entirely constructed for this purpose, of dimensions that would give the horse his liberty, and where he is intended to be chiefly kept during the two or three months of summer. On this floor might the Larvæ, by examining the dung two or three times a day, be collected, and thus fully grown Larvæ being obtained, there would be no difficulty in raising them to the state of a Fly by keeping them in boxes filled with earth, or a mixture of dung and earth, till the Fly appeared. In this way what is unknown of their sexes, species, and history, might be correctly made out, and further on the Fly coming forth, if confined in a suitable apartment, they might even be presented to the Horse, and the mode of depositing their eggs be seen, their copulation having been first permitted, which Vallisneri informs us they are not shy in performing *coram teste*.

I am induced to notice in this place a Fly belonging to this genus, a figure of which is given at No. 28, and whose history we are at present quite unacquainted with. I obtained it, with some other Insects in the sale of Drury's collection, about ten years ago, and by way of distinguishing it till its history becomes known, shall bestow on it the name of *Oestrus Microcephalus*. It may be the Oe. Trompe or Pecorum of Fabricius, or both.—See the description at the conclusion of this essay. Its general appearance, and the distribution of the tendons of the wing, would lead me to refer it to the *Cuticular Oestri*.

Another species also, whose history we are at present in the dark about, is given at No. 30, which I formerly placed under *Hæmorrhoidalis* as a variety β, but observed that it differed from it in the essential circumstance of having a large white wing-scale: β variat squamâ halterum majorî lacteâ magnâ ac facie magis depressâ. Lin. Soc. Trans. Vol. III. p. 328. It has since been taken on the heaths near Plymouth by Dr. Leach, who has

named it *Oe. Ericetorum*, but now conjectures it is no other than the male of the Oestrus Bovis.

Its face strongly resembles that of an ape, and the remark in my dissertation above quoted was made from observing this species. "*Frons etiam quadrupedis nonnihil simulat, presertim simiæ: hoc in Oe. Hæmorrhoidali maximè conspicuum est,*" &c. Lin. Soc. Tr. 3. p. 325. The hairs in the upper part of the face also form an arched projection not very unlike the projection of the skull of the monkey over the orbits of the eyes, and the black antennæ sunk in the head, have much the appearance of eyes.—See fig. 32.

On the probable Effects of the Gastric Oestri *upon Animals.*

Unacquainted with their history, the appearance of inhabitants like these in the living stomach, would, to superstitious people, or even in strong minds, produce apprehensions of their pernicious or fatal effects, especially when they saw the coats of the stomach eroded as it were in holes nearly through by them; yet but few horses exposed on the commons can escape having them, and the perfect health they enjoy with them is a proof sufficient of their innocuous nature and harmlessness in a general way.

That the coats of the stomach are not particularly irritable to mechanical stimuli, is proved from daily experience by offences committed against them. Some kind of fishes have their stomachs completely perforated through by the bones of the fishes they feed upon, without any derangement of their health, or probably much sensation; and the white tissue of the Horse's maw is certainly less sensible than the other parts of the stomach, that it is fair to conclude our apprehensions of their effects have been carried much too far: if the tone of the stomach should be changed by inflammation or other disease, their roughness might

perhaps become then very sensibly felt, and their powers be changed. That they contribute to health in some degree is, I think, very probable, for notwithstanding the apparently unnecessary existence and cruel effects of the Oestri, they are probably not altogether without an use, and were not designed by Providence to add, without a recompense, to the numerous sufferings of these useful and laborious creatures.

A physiological view of their effects will, perhaps, best justify their existence, and save them from such an imputation.

To see the full purpose of their existence may not be within our power in our present state of knowledge, yet we nevertheless may introduce some remarks in this respect as a foundation, and whether a permanent one or otherwise, we shall not be tenacious about; they may, at least, lead to further consideration and research concerning them.

Throughout nature the benevolent design appears of leaving no place idle or unoccupied, that can conveniently or usefully afford a home and happiness to some being suited to it, and which sometimes, in its turn, may also be made to contribute to the welfare of the animal it is given to infest.

These parasite animals, though uncouth and almost of themselves a disease, may prevent the access of worse diseases, and in such situations as would produce them of a fatal nature, and prevent it by their local effects. Children of cachectic habits breed worms faster than healthy children, which may tend to suppress or moderate the disease they incline to; and sheep, in low damp situations, which might produce a worse disease, become in these situations particularly infested with these parasitic animals. Linnæus, in respect to Pediculi or Lice, has admirably observed, "*Rodendo caput exciat achores apud puerulos voraces incarceratos indeque strumosos et sicque preservat a coryzâ, tussi, cæcitate, epilepsiâ,*" &c. That is, that Lice, by gnawing or irritating the skin of the head, excites a sort of running sores amongst boys

kept in filthy workhouses, or confined places, and become strumous or swoln by the confinement, by this excitement are preserved from coughs, wheezings, blindness, epilepsy, &c.——In more cleanly situations they would not be subject to one, nor then would they be so obnoxious to the other, or in any considerable degree however. Some constitutions, inveterately subject to the *morbus pediculosus*, would perhaps serve to confirm this remark; also by their having a strong tendency to some disease which these animals may tend to avert, and in which constitutions the facility of their propagation becomes in a wonderful manner increased so as to almost defy their eradication, which in stronger constitutions, and free from disposition to disorder, would not be the case. These Gastric Oestri, perhaps, in a state of health, without producing the terrible consequences usually apprehended, may tend to preserve it by their gentle stimulus to the stomach, and by promoting the digestion of their low watery food, prevent the cholic, gripes, and other indigestions which ultimately affect the head of the Horse, and producing staggers, a disease the horse is particularly subject to.

Nor is there wanting abundant proof of the utility of local irritations in preventing the access, as well as in curing disorders. We often see a formidable disease quickly removed by blistering the skin, or by irritating the mucous membrane of the stomach or intestines by a vomit or purge. The appearance of exanthematous eruptions on the skin, and the formation of local abscesses, from the same cause of partial irritation, often relieve a general disorder of the system. The mucous membranes and the skin possess this power when irritated in the most eminent degree, and to these the Larvæ of the Oestri are applied. Irritating the membranes of the stomach in other animals would excite nausea and vomiting; but the Horse not possessing this power, his stomach is peculiarly fitted for the stimulus of such inhabitants.

It has also been remarked in hospitals, that a patient afflicted

with a wound, ulcer, or other severe local complaint, is not so susceptible as others similarly exposed to the contagion of a fever or other general disorder.

How far the access of those dreadful disorders which sometimes arise of themselves in cattle and horses, and afterwards become contagious, as the murrain, glanders, farcy, &c. may be prevented by these peculiar irritations, it will not be easy to discover; nor whether that singular tendency or disposition in the Horse to inflammatory complaints, as the *caligo* of the eyes, termed moon-blindness, inflammations of the lungs and of the bones, as spavins, splints, &c. may be in any degree checked or subdued by the presence of these local *stimuli*.

In confirmation of this suggestion I may remark (although I am aware other reasons may be also assigned for it,) that those Horses which are not exposed to the Bots, more frequently are infected with the glanders, farcy, &c. as those of the army, post-coaches, post-waggons, and dray-horses, for these can rarely be spared, from the nature of their work, to graze on the commons, and thus be exposed to receive them.

If, after a more minute research into their effects on the system, the utility of these native stimuli of animals should be established, and, like the leech, or the cantharides, they should be called in to the aid of veterinary medicine, I may venture perhaps for the first time to suggest that it would not be impracticable to administer them artificially by means of their ova or larvæ in any given quantity.

If the stimulus is considered as of too gentle a nature, it is in some measure atoned for by its permanency, and the unlimited power of increasing the dose; at least it must be acknowledged that by the administration of them in this way, we might accurately ascertain their real effects, and whether they are so fatal as has been imagined.

Desirous that my horse, which had not been to grass for some

years, should have their wholesome stimulus, I cut off the hairs from another horse charged with the Bot's eggs, and gave him about three dozen of them. He afterwards grew fatter, and in better condition than I had ever known him, whether from their effects or not I do not undertake to determine, but think it not improbable they contributed to it.

In Nasal Farcy Gleets of Horses, I have followed this suggestion of stimulating the stomach by Cantharides in small doses, and by the Sulphat of Zinc, with great success, curing several that were considered glandered.

The domestic animals in a particular manner appear to be the objects of this species of natural stimuli or vellicatories, which as they are also frequently forced by man into unnatural exertions and unhealthy situations to suit his views and convenience, so therefore they may stand more in need of this sort of protection. Their impressions may be hardly cognizable to the senses, and produce nevertheless powerful effects upon the stomach, and thence to the system at large, as we see in the case of spices given with food, and fomentations, mild blisters and sinapisms to the skin.

How dirty in warm climates would men become, if it was not for the fear of the increase of vermin, that they can stimulate to industry therefore is certain, and so to health. Animals would become inactive in warm weather, perhaps fatally so, if it was not for the stimulus of flies and other insects, which by teazing prevent it.

Those who consider the Bots as a plague would no doubt be desirous of being informed how they should best destroy them. One great utility in the study of natural history is, that it affords us a knowledge of the habits of these animals, and by these we are taught the most effectual measures for this purpose. It is indeed truly difficult to detach them from the stomach by any medicines or poisons administered internally, though there are not

wanting abundant nostrums for this purpose among the numerous professors of horse physic. At the natural annual period of their transformation they come away readily enough of themselves; and if it happens at the time that any medicine has been exhibited, it is considered as proof enough of its efficacy, and mistaken for the consequence of it; so easy is it to draw wrong conclusions. Neither opium or tobacco given for several days have any effect upon them, as I have witnessed by opening the stomach after the death of such, and finding them lively and well. We can, it is true, force the poison down the horse's throat, but we cannot afterwards get it into the throat of the worm, who is placed in his own element, and can refuse the food that does not suit him. Truly is it therefore difficult to destroy them by means of poisons thrown into the stomach.

Oils, to close the pores of respiration, and thus kill them, was a favourite suggestion of the last age for worms of all kinds, and it was thought *must infallibly kill them:* nevertheless it did not. These oils probably in the stomach are soon reduced to a soap, and digested; how much less then could it affect worms situated in the intestines.

The wisest measure for securing animals from their effects is to prevent their propagation or access, and their habits expose to us an effectual mode of doing this. The eggs of the *Oestrus Equi*, which are very conspicuous on the knee, the mane, and the sides of the horse, may be washed off by a brush and warm water, or still more effectually removed by a pair of scissars. The same may be done for the Hæmorrhoidalis from the lips and beard.

The other species being smaller, more rare, and probably less troublesome, require therefore less our consideration.

In respect to the Hæmorrhoidalis also, where horses have been much out at grass the preceding year, they should occasionally in the warm months of the next summer be examined for them, when they will be found, as we have already stated, hanging to the

extremity of the rectum, and should be removed by the fingers. The destruction of a single one at this season of the year is not only the death of an individual and its effects, but the almost certain destruction of a numerous progeny; it is also useful in preventing the irritation which the spines of the Bot occasion to the anus, which irritation becomes very distressing to the animal if he is used on the road, occasions him to move awkwardly, wriggle himself about, and to be sluggish, and though beaten severely he soon relapses again into his awkward manner of going; which as this happens generally in warm weather, is most commonly attributed to mere laziness.

Some further remarks on their probable effects we leave till we treat of the Cuticolar and Cavicolar Oestri.

* * *Second Family*, Cuticolæ.

The Oestrus Bovis, *or* Gad Fly.

Of all the European species of this genus, this is the largest, and is not unfrequently seen in country situations in the backs of oxen and cows. They form tumors as large as pullets eggs on the sides, about the back and loins. See their appearance, Plate II. fig. 2, *a* the tumor or abscess, *b* the external opening. With us among the country people they are called Warbles, Wornils, Wormuls, and sometimes Bots.

When I first took up the investigation of these animals, I was in considerable perplexity what this species could be, since I possessed the Oestrus Bovis of Linnæus, agreeing perfectly with the description, and which was a Horse Bot; nor had I then seen the writings of Vallisneri or Reaumur, which, as Linnæus had seen and referred to, I did not suppose could have fallen into such an error as to have omitted entirely this remarkable species, or have confounded it with the Equi, but it so proved, and on obtaining the perfect insect from the back of the cow, the mys-

tery became unravelled; for I was not certain, indeed apprehended after such authority, that the same species inhabited both animals as Linnæus had stated, " Habitat intra Boum dorsum, in ventriculo Equorum sæpe ipsis lethalis." Lin. Syst. Nat. p. 969. This insect was not known to Linnæus, and, indeed, has been rarely seen; Vallisneri, after years of labour, procured only one mutilated specimen of it; and Reaumur, after great pains and expence, only two or three. A mode of obtaining this fly, which succeeded with me perfectly well, I shall now describe, by which I obtained out of three larvæ two perfect flies, one so perfect, that it flew away while I was making some experiments in presenting it with different objects; the other I gave to Thomas Allen, Esq. after drawings had been made from it for the use of the Linnæan Society. One I also fortunately caught of these flies, between Salanche and Bonneville, in Savoy, flying in the road, and settling on some dung where cattle had recently passed; this specimen, on my return through Germany, I presented to the venerable and worthy Professor Daniel Schreber, of Erlang, the intimate friend and pupil of Linnæus, who till then had not seen it.

The following is the simple means for obtaining them perfect, which may be not unacceptable to those who for their cabinets or from curiosity may wish to see them:

During the latter months of the summer, about which time the larvæ are found fully grown, and about to quit their habitations, which can be known by the superior size of the abscess, and especially the increased diameter of the external opening; such being selected for the experiment, we remove the hairs round the tumor to a considerable distance with a pair of scissars as close to the skin as may be; and a piece of leather, thickly spread with pitch, being provided, through the center of which a hole is cut about the size of the finger, and into this a small gauze pouch or bag is inserted, hanging out an inch or two from the leather: this plaister with its pouch is then placed upon the

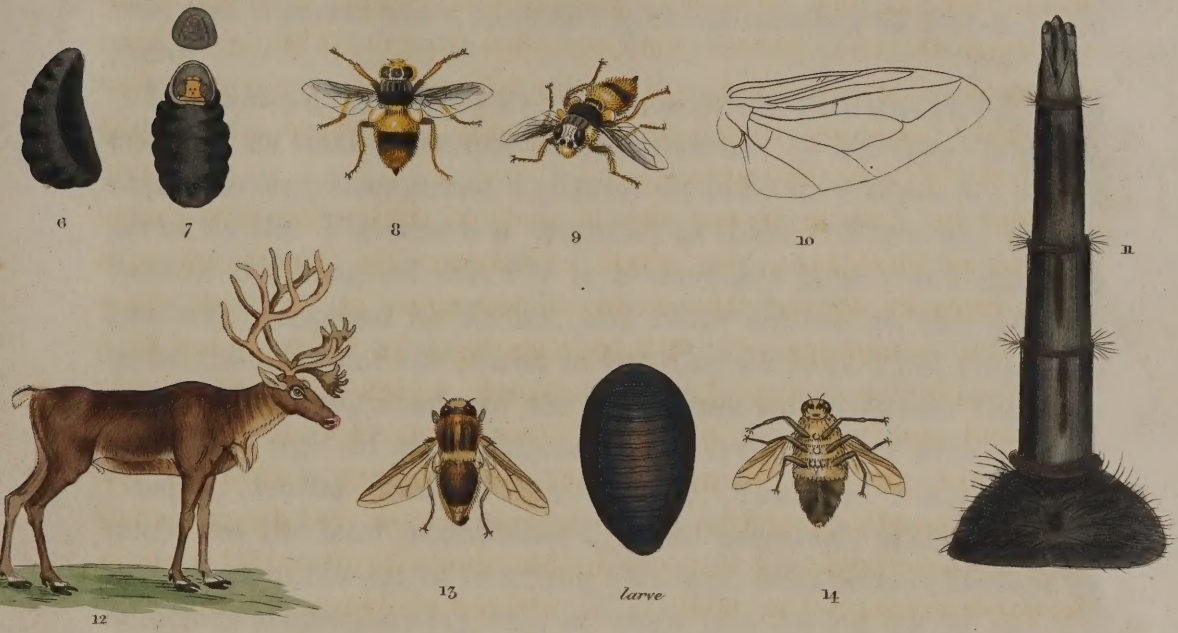
skin, to which from its warmth, which is very considerable, it readily adheres, the pouch being opposite the opening. Whenever the insect makes its way out and falls from the abscess it is caught by the bag, in which, as it cannot escape, it remains till removed by the person looking after them. The larva thus obtained, as it is full fed, will hardly fail to produce a perfect fly; it is only necessary to put it into a pot with some loose light earth for it to change upon.

That we may continue the history of these flies with some degree of uniformity, we shall commence its operations with some remarks on the deposition of the eggs, as we have done with the former species. This act appears to be attended with severe suffering or apprehension at least, which makes the cattle run wild and furious and gad or stray from the pastures; and hence the ancient epithet of Gad-Fly. When yoked to the plough, the attack of this Fly is attended with real danger, since they become perfectly uncontroulable, and will often run directly forwards through the hedges, or whatever obstructs their way. There is provided on this account, to many ploughs a contrivance immediately to set them at liberty. When the cattle are attacked by this Fly it is easily known by the extreme terror and agitation of the whole herd; the unfortunate object of the attack runs bellowing from among them to some distant part of the heath or the nearest water; the tail, from the severity of the pain, is held with a tremulous motion straight from the body, and the head and neck stretched out to the utmost. The rest from fear generally follow to the water, or disperse to different parts of the field. See Plate II. fig. 1.

And such is the dread and apprehension in the cattle of this Fly, that I have seen one of them meet the herd when almost driven home, and turn them back, regardless of the stones, sticks, and noise of their drivers; nor could they be stopped till they reached their accustomed retreat in the water.

Oestrus.

1 2 3 4 5

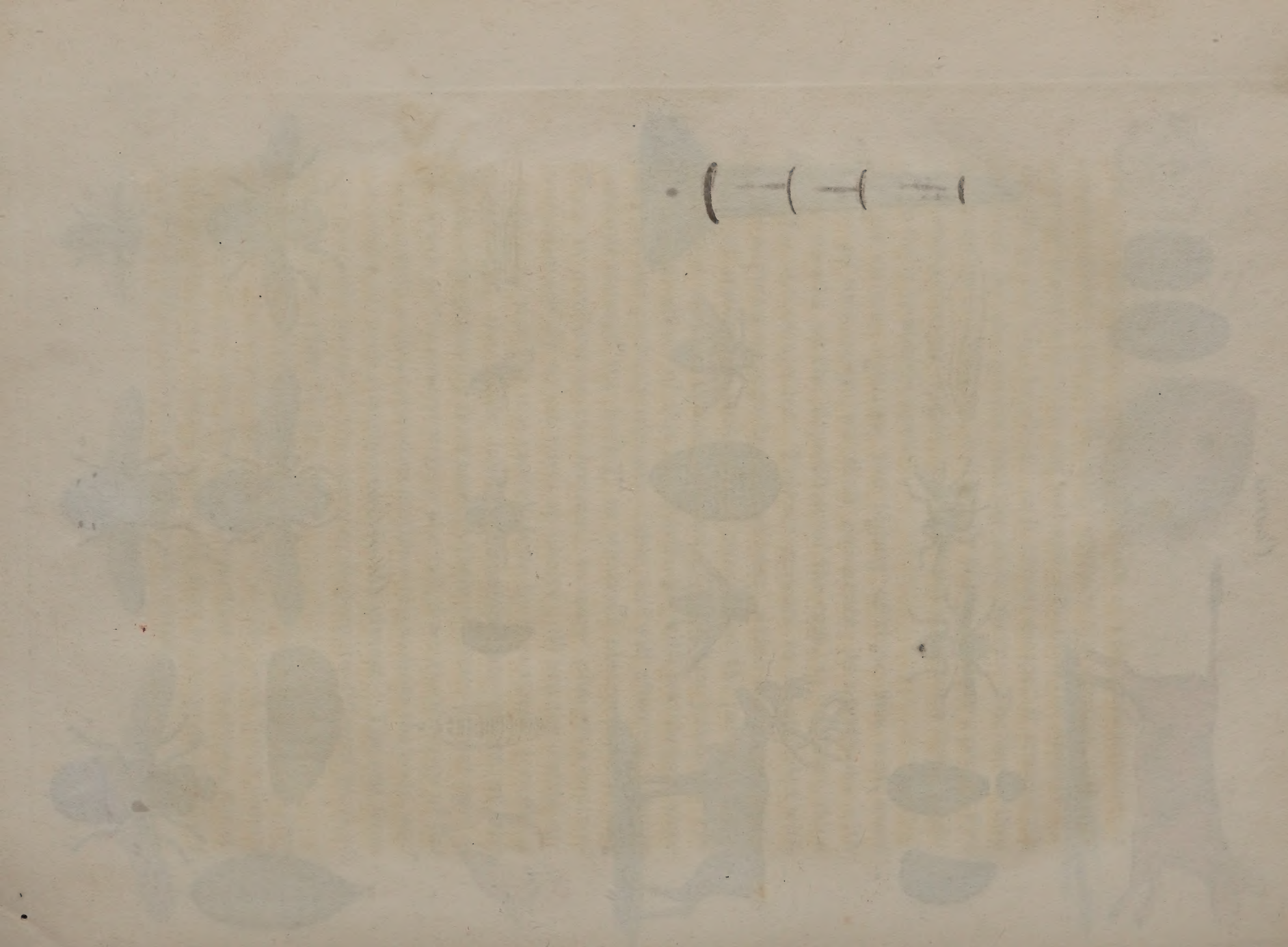


6 7 8 9 10 11 12 13 14

16 17 18 19 20 21 22

Cuterebra.

24 25 26 27 28 29 30



The strongest and healthiest beasts seem to be preferred by this Fly; and with the dealers in cattle their possessing them is held a criterion of goodness. The tanners, also, observe their best and stoutest hides have the greatest number of Bot-holes in them.

It is not yet satisfactorily ascertained, whether this alarm is the effect of an instinctive fear of the Oestrus; or whether, in depositing the egg they inflict a painful wound; or if there is a sound given by the Fly which is frightful to them. The scale at the base of the wings of this Fly is remarkably large; and this part has been supposed by Keller, and other writers on this subject, to be the organ of the sound or buzzing we hear from these animals. This magnitude of the wing-scale would favour the opinion of Virgil of their attack being accompanied with a noise "asper, acerba, sonans," &c. Those, however, I saw in flight made not the least sound that I could perceive; still it may be true, that in the act of inserting the eggs, from certain feelings or emotions accompanying this act they may be led to do so. In the Rhein-deer Gad-Fly Linnæus saw the egg protruded and held out upon the point of the abdomen, like a white seed, ready to be placed upon the skin of the animal; he makes no mention of any sound accompanying it in this Fly, and this circumstance of the protrusion of the egg would lead us to infer, that no wound is inflicted by the Fly, whose tail, like the tube of a telescope, piece within piece, appears of a nature no way calculated for such infliction. The *Ichneumon Fly*, we know, deposits its egg upon the naked skin of the caterpillar, which egg adheres strongly to the skin, as though glued to it; and the little grub, on the hatching of the egg, makes its way through the skin into the body of the caterpillar, and there feeds till ripe; and it is equally possible, that the skin of the ox is perforated by degrees by the young larva of the Gad-Fly, till it obtains its situation beneath the hide. The animal is so frighted that it has not the

power of lashing them off with the tail. Sometimes horses, also, are attacked by the Gad-Fly, and I have been witness to four or five instances of these larvæ being found beneath the skin of the horse, the parent Fly, driven perhaps by necessity and the want of proper opportunity of depositing it among the cattle: whether they ever arrive at maturity in these cases I am not assured.

The larvæ of the Cuticolar Oestri are very unlike the Gastric larvæ, so much so, that I could hardly imagine that they would produce an Oestrus till I actually procured the Fly from it.

Removed from the abscess this larva is found of an oblong figure, larger at one extremity than the other, which larger end is placed upwards in the abscess, has the respiratory plate, and is applied to the external opening of the abscess. The body of the larva is divided into ten or eleven segments or sacculi by transverse bands; these are crossed again or intersected on the sides by six longitudinal lines, pursing up the skin, and forming the sides of the larvæ into so many papillæ or nipples, each possessing at its extremity a respiratory pore. See Plate II. fig. 3. These larvæ have not the long acula upon the edges of the segments, as in the Horse-Bot; but they have an apparatus which serves much the same purpose, but in a milder degree, for there are observable on a more close inspection, ridges of dotted prominent lines passing transversely round the body of each segment, and interrupted irregularly by the longitudinal lines above described, leaving smooth intervals between them: of these there are two kinds, a narrower and a broader line of minute dots or points; the first, or narrower line, is easily seen by using a lens to be formed of hooks bent upwards or towards the tail of the insect. See fig. 3. *a*. And on examining the broader lines, consisting of smaller dots, fig. 3. *b*. with a powerful magnifier, they also may be seen to consist of hooks, but smaller, and turned in the opposite direction, or downwards in the abscess, and towards the head of the insect. It is probable, by means of

these hooks, erected by the muscles of the skin, the animal raises or depresses himself at pleasure, or turns about in the abscess and finally crawls out of it when ripe. The use of the terminal tentacula, observable in the Gastric species, would have been useless in this, as the oval form of the abscess retains them in their abode sufficiently secure. And by the motion of the larva in the abscess these hooks, by irritating the surface of the sac, produce a discharge of pus for sustenance.

In what manner the nourishment is received by this larva is not immediately discoverable. Indeed, it was not known to me till an unexpected circumstance led me to its discovery; on immersing one of these larvæ in warm water with a view to rid it of pus and slime, I observed a considerable quantity of pus to be ejected from an aperture, which at other times was closed, this was at first considered to be the mouth; it, however, was found on further research to be the real anus of the larva, for it is in the upper part of the larva, or that end which is applied to the external opening in the skin, (where may be also observed two small horny plates,) which are found on dissection to close the extremities of the trunks of two large air vessels. Near to these plates, and somewhat above them, this minute puncture is discernible. At other times, when closed, it was discernible with the utmost difficulty. At fig. 3. is represented this aperture, *a*. together with the two horny plates, which close up the air vessels, being a view, very considerably magnified, of this upper extremity of the larva.

From a first view, this part would appear to be the head of the larva, being uppermost in the abscess; but as it is found to produce the extremity of the abdomen in the future insect, it must, therefore, be considered as the tail; and the above-mentioned minute aperture is undoubtedly the anus, and is found to be in conformity to the same situation of the anus in others of this

genus. And this would seem to render it manifest, that through these plates they receive the air, and emit it by the spiracula.

At the lower end of the larva, fig. 3. a small indentation may, with attention, be observed, which is the mouth of the larva. It is a simple aperture, and altogether unprovided with any of the apparatus belonging to the mouths of larvæ in general; and near the mouth are seen two black points of horn, which appear to be perforated in the centre, and are found by dissection to be the termination of two considerable branches of the air tubes, and correspond to the two nipples on the first segment of the larva of the Œ. Equi. An enlarged view of the mouth and inferior part of the larva of the Œ. Bovis is seen in fig. 4. Round the orifice of the mouth are placed some projecting mamillæ, which are imperforate, and perhaps serve the purpose of feelers.

The intestinal canal in this larva is a simple membranous tube, which extends from one extremity to the other, and serves the double purpose of stomach and intestine.

In the larva of the Oestrus Bovis there are only two principal trunks of air vessels, which are connected near their origin by a lateral trunk. From these trunks branches are seen passing in every direction through the parenchyma or matter of the body of the insect, some going to the intestine, others to the skin, and a greater number appear to be forming an anastomosis with each other.

When young the larva is smooth, white, and transparent; as it enlarges it becomes browner; and about the time it is full grown it is totally of a deep brown colour.

The larva having attained its full growth and size, effects its escape from the abscess by pressing against the external opening, which occasions its enlargement by the points pressed upon being absorbed, and the skin also may give way and extend itself under their impression. When the opening has obtained the size of a

small pea, the larva writhes itself through, a ring or segment at a time, till arriving at the narrower part of its body it falls out, and tumbles to the ground, and seeking a convenient retreat becomes a chrysalis.

After leaving the abscess, and preceding their change, they contract themselves into a much smaller space, and assume a different figure. See Plate II. fig. 4. They never change or throw off their skin, apparently, but the same serves them through their whole growth, and at length also forms the shell of the chrysalis, as in the other species of this genus.

If we examine the sac which enclosed the larva beneath the skin, it appears formed of condensed cellular membrane, and is rough on the inside. The pus secreted is mostly of a yellow colour, and sometimes flows from the opening, and dries about the orifice. After the exit of the caterpillar the abscess disappears, and the wound in the skin closes up and is healed in a few days: but although the skin heals up on the exit of the larva, we may remark, that the union is not so firm as was the original skin, but is affected by a sort of agglutinating deposit, which afterwards on the skin being dried and hammered by the tanners gives way and cracks again in these places, shewing the union to have been of a less perfect nature than the original skin; the succedaneous nature of the repair of broken skin, has been remarked by late physiologists, and we mention this fact as confirmatory of their doctrine.

The chrysalis is of a dark brown colour, and in figure somewhat resembles the half of a walnut shell, being narrower at one end than the other, and flat on one side, and very rounded and convex on the other. See fig. 6. Those which I bred remained in the state of chrysalis from the latter end of June till about the middle of August, when the Fly appeared. I have, notwithstanding, observed full grown larvæ in the backs of cows as late

as the ninth month, or September, which must have produced their Flies as late as November or December, or perhaps not till the ensuing summer.

The larva after being immured in the chrysalis a sufficient time, and its soft members dry and in a degree hardened, bursts from its confinement by forcing open a very remarkable triangular lid or operculum, see Plate II. fig. 7. and makes its way out at the small end, *a*. The position and appearance this Fly makes in the chrysalis is also given.

The larva at the period of making its way from the back of the beast is weak and tender, and exposed to imminent danger, if on land, of being trod on by the cattle or picked up by birds; if on the water, where the cattle stand during great part of the day at this hot season of the year, it perishes by drowning or becomes the food of fishes.

It is worthy of remark, that Reaumur has stated that its escape from the back of the beast usually takes places at a very early hour of the morning, at two or three o'clock, or at sun-rise, now if it be so it is remarkable that in this way much of the danger is avoided, as the animals at this time would most probably be upon dry land, and in a more quiet state than at mid-day, and the birds also would not then be present.

The Fly thus singularly produced, is large and handsomely coloured, see fig. 8. and 9. Plate II. and its description at the conclusion of this Essay; its wings and tendons, fig. 10. and the abdominal stylus of the female for depositing the eggs, according to Reaumur's drawing, fig. 11. To the extremity of the abdomen of a specimen of the Oestrus Bovis which I possess, there is something visible like a hard white stylus, or rather spine, of whose nature I am not assured.

As to their effects, they may be perhaps not inaptly considered as the living rowels of the ox, producing in all respects the same

effects as an artificial inserted rowel, issue, or seton, would do; and these perhaps first suggested in ancient times to practitioners in medicine these very useful remedies.

The cattle are subject at times to violent cephalic disorders and epidemics, especially in the warmer climates, which these natural cutaneous irritants or suppositories, as they may be called, may tend to avert; and they may operate in a more forcible and determinate way, in producing all the effects of the Gastricolar Oestri, already noticed, the skin having such a general sympathy.

In respect to the riddance of them where they may be conceived mischievous, we may observe, that the larva of the Oestrus Bovis, which breeds in the backs of horned cattle, is so conspicuous, that it is more easily destroyed than the others: the injection of any corrosive liquor into the sinus would kill it; or by puncturing the larvæ with a hot needle, introduced through the apertures in the skin, or even by simple pressure, they may be destroyed, afterwards extracting them, or leaving them to slough away, which I have frequently observed they do when crushed by a blow from the horn of the beast, or by any other accident, without any material injury to the animal. A man employed for this purpose might, in half a day, in this manner destroy every bot on a large common, the beasts being suffered to pass one at a time in review before him.

Of the Oestrus Tarandi, *or Rhein-deer* Gad-Fly.

The Rhein-deer delights in the cold of the north, and appears destined most beautifully to fulfil by himself to the polar inhabitant the various offices of the horse, cow, and sheep, of the more southern regions, carrying burdens, giving milk, and affording clothing: and this worthy animal appears in a remarkable manner to suffer from the effects of the Oestrus, with which he is infested, more than the other domesticated animals, so much so, as to occasion

the Laplander to quit his abode several months of the year, and oblige him to go with his Rheins into the Upland Alps, in order to avoid their effects. The gnats or musquitoes also, in these regions are more troublesome than in any other part of the world; so that not only the rigours of the climate, the unproductiveness of the earth, and the hard condition of life, but the very insects appear to contribute to drive men from these situations into more hospitable latitudes.

The Rhein-deer Bot had attracted very little notice till the writings of Linnæus presented many interesting details respecting them to the lovers of natural history; and from his various scattered notices or memoirs we have extracted the following details:

In the *Flora Lapponica*, p. 360, in describing the Agarics and Lichens of this part of the world, he introduces his remarks on the Rhein-deer Gad-Fly; as the Rhein-deer is chiefly fed during the winter on one of these, the *Lichen rangiferinus*, which is very abundant in the north, as though provided for them, and is serving perhaps in some instances also, as a covering from the inclemency of the weather to vegetables.

He afterwards in a sort of journal of his tour, written in Swedish in the *Acta Stockholmia* for 1739, p. 119, gives further particulars of their history. And in the *Acta Upsaliensia*, 1736, p. 102, he enters again on this subject with some variations.

Their depredations he describes as most bitterly felt by the inhabitants of these regions; and after a few pious and admiring reflections on the ways of Providence in providing for these Flies in their delicate and tender larva state, he observes, that in his journey into Lapmark in the year 1732, he found all the inhabitants had quitted their plains and woodlands for the hilly country and Alps. One only he found dwelling there with his Rhein-deer (Rheno), whose horns, soft, tender, and sore, were miserably punctured by the Tabani till they distilled blood; and that the gnats also joined in the persecution with their little trunks con-

tinually infesting them. The animal, to avoid their effects, would prostrate himself before the little hut of the Laplander, and be secure from the teazing of his enemies by the smoke of the burnt agaric, which proceeded from it.

On passing afterwards into the Lapland Alpine country he observed a Rhein-deer, loaded with his own pack, frequently to stop short and become suddenly quiet and motionless as a pillar of stone, or one struck with catalepsy, the head held out straight, the ears upright, and eyes fixed; nor by any ill treatment could he be induced to proceed, but in a little while he would again resume his march.

Early one morning, while he was in bed between two skins of the Rhein-deer, he perceived a very ungrateful stink, when daylight appeared there were standing about the cot a thousand of these Rhein-deer, driven by old men, young boys, dogs, and women, who milked these animals. They appeared to be under the apprehension of some invisible attack. The animals carried their heads aloft, their ears pricked up and extended, beating the ground and kicking in the air with their feet, as though by enchantment; then for a while they would be quiet, then again they were seen most furious, and this with so general and regular a movement, that no army would have surpassed their exercises in uniformity. On asking the Laplanders the cause, they told him it was these Flies.

Anxious to ascertain the truth of this, he was able with nice observation and scrutiny, to perceive flying backwards and forwards in the air some of these Flies, which he endeavoured to catch, and assisted by the Laplanders succeeded in taking four or five, which he sat down with pen and ink, greatly to the amusement of the Laplanders, to describe, which occupies the remainder of this pleasing essay, and which we shall give with the others at the conclusion.

He observes, that those which he took had no weapon at the

extremity of the tail for inflicting a wound, nor was there in the mouth any aculeus; that their effects upon the Rhein-deer in so driving them did not admit of explanation. He describes the abdomen as having a telescopic tube at its extremity, which is probably similar to the one already given with the Œ. Bovis, and is peculiar to the female, as in other Flies. On observing the tumors in the back a few weeks afterwards, that had been touched by the insect, he found an opening that would admit a goose quill; he squeezed these tumors with his fingers, which the animal could but badly endure, but he persisted in pressing them till he made the larva come out through the opening, which he describes as being white, of an oval figure, extremely tender and delicate, the extremity black, which presented to the opening. The body with circular folds and curved lines.

One of these flies he describes as following the rhein-deer that carried his clothes, and was always near or upon the animal; she had her tail held out, and carried rather to one side and curved upwards, and upon its extremity a white egg, as large as a cynips, or hemp seed perhaps. I had (he says) an opportunity the whole day of seeing this insect continually following him, and sometimes going before him; and so careful was it about depositing its egg, that it did not care to place it upon the rein-deer if it did not stand tolerably still, but dropped it on one side; and so persevering was it to follow him, that at last it became exhausted and fainted away, and fell down on the snow mountain with fatigue, so that it could be taken with the hands, but shortly after, when it had been a minute on the snow and recovered itself, it flew to the next green spot, where it rested, and then again pursued the rhein-deer.

It was curious to observe the striving of the dogs, the boys, and the rhein, which would run many times round the hut of the Laplander, before it would proceed to the pasture where it was to feed, if with the wind, but against the wind the rein would proceed with alacrity, for by his flight when proceeding in this

direction he could outstrip the fly which, forced back by the current could not so easily follow him. At break of day, and in the evening, it was curious to observe these conflicts. He observes how admirable it is that these Insects are secured from the cold by their provident Creator, by the dense warm covering, and the thick matted long hairs of the Rhein-deer's back, and that the back and not the sides is chosen for their nidus, otherwise the animal by lying down would crush them. And the long hair of these animals in summer, standing upright, and detached as it were from the skin, enables the Fly to deposit her egg between, on the more exposed and naked parts. And the times of their formation in the backs is the time of the rhein-deer shedding his horns; and the stumps being then soft and tender, prevents his destroying them. Linnæus also compares its effects to that of a fontanelle or issue, formed by a pea in the human subject; and how wonderful, he observes, it is that so large an animal, which might defy the strength of man, cannot nevertheless defend himself from, or resist the attacks of this small Fly.

He says that a third part of the rhein-deer, if I understand him rightly, are destroyed by this fly, occasioning the disease the Laplanders call *Curbma*, the name they give to this fly. Their effects perhaps in this respect are exaggerated, and the deaths, from whatever cause, too easily attributed to this troublesome insect, as the death of horses has been too often to the Equi, by the ignorant.

Some farther circumstances respecting them appear in the *Lachesis Lapponica*, or Lapland Tour of Linnæus, the translation of which from the Swedish has been lately published by Sir James Edward Smith, Vol. II. p. 38:—" These animals are sometimes attacked with a vertigo or dizziness in the head, which causes them to run round and round continually. The people assured me, that such of them as run according to the course of the sun, may be expected to get the better of the disorder; but those

which turn the contrary way being supposed incurable, are immediately killed. The recovery of the former is thought to be promoted by cutting their ears, so as to cause a great discharge of blood.

" The *Kurbma* or ulceration caused by the Gadfly takes place every spring, especially in the younger fawns. Such as are brought forth in the summer season are free from this misfortune in the ensuing spring; but in the following one many of them lose their lives by it. When come to their full size and strength, the consequences are less fatal: but no rhein-deer is entirely exempt from the attacks of this pernicious insect.

" Such of the male rhein-deer as are destined to serve for a stock of provision are killed before the rutting time, and their carcasses hung up, exposed to the air and frost before flaying. The flesh is smoked, and a little salted, and then laid upon sledges to dry in the sun, that it may keep through the winter till spring. About the feast of St. Mathias (Feb. 24) the rhein-deer begin to be so incommoded by the Gadfly, that they are not in a fit condition to be slain for eating. From that period therefore, till the milking season, the Laplanders are obliged to live on their stock of preserved meat. At other seasons of the year the females are killed for immediate use, according as they are wanted." Vol. II. p. 42.

Other particulars are also given in these volumes, but as they were derived from the mistaken information of these untutored people, I forbear their insertion; and Linnæus himself had omitted them in those communications quoted at the beginning of this account, probably from suspecting their correctness.

At fig. 12 is seen a sketch of this interesting animal; 13 and 14 views of the Oestrus.

Linnæus has remarked, that the Buphaga Africana draws forth these larvæ from the backs of the oxen. Syst. Nat. I. p. 154. And in the Amænitates Academicæ is found also a repetition of the

above details respecting the Oestri, Vol. IV. p. 157; and where the same circumstance is asserted in respect to the crows also drawing them out from the backs of the rhein-deer: *Cornices prosequuntur Rhenonem ut Oestros dorso inhærentes extrahant et deglutiant, quod quamvis Rheno non facile admittit, fatigatus tamen, ferre sæpius coactus est ut mihi narravit Dn. Er. Fiellstroem in Lapponia ipse natus.*

**** Oestri Cavicolæ, or Face-Bots. Of the* Oestrus Ovis, *or* Sheep-Bot.

The eggs of this species I have not yet seen, the sheep being very shy under their attacks, which renders it difficult to approach them near enough to see the actual operation; the obscure colour of the fly also adds to the difficulty. The sheep are exceedingly annoyed with them, and to defend themselves get into the roads in dry hot weather, and lie down along the dusty ruts, holding their heads close to the ground, which makes it difficult for the fly to get at them; at other times one finds them standing up, with their heads held low, almost to the earth, and the nose turned between the fore legs, their nose being nearly in contact with the ground. This mode of defence must render the attack of the fly exceedingly difficult; at other times, when in the open field, they congregate together, forming a dense compacted mass or phalanx, which, except to the exterior ones, is scarcely accessible to the fly, the noses of the greater part of them pushed against each other, or held nearly close to the ground; in this way those placed in the centre must be very secure.

The manner in which this species deposits its ova, has not, I believe, been described; nor is it easy to see, though close to the animal at the time, exactly in what way this is accomplished, owing to the rapid motion and obscure colour of the fly, and the extreme agitation of the sheep; but from the actions of the sheep

afterwards, and the mode of defence it takes to avoid it, there is little doubt that the egg is deposited on the margin of the nostril. The moment the fly touches this part of the sheep, they shake their heads, and strike the ground violently with their fore feet, at the same time running away, and holding their noses close to the ground, and looking about them on every side to see if the fly pursues, and as they go along they often smell also to the grass, and look anxiously into it, lest one should be lying in wait for them; if they observe one, they gallop back again, or take some other direction. As they cannot, like the horses, take refuge in the water, they have recourse to a rut, dry dusty road, or gravel-pit, as a defence, as we have before remarked. Pl. II. fig. 16.

Observations on these flies are best made in dry weather, and during the heat of the day, when by driving the sheep from their retreats, the attack of the fly and the emotions of the sheep are easily observed.

I imagine the nostril becomes highly inflamed and sore, from their repeated attacks, and the consequent rubbing of the nose against the ground, which, together with certain instinctive apprehensions of these flies, occasion their touch to be so much dreaded.

From the difficult and precarious mode these Oestri pursue in depositing their eggs, they cannot succeed in depositing but a few in each sheep; whereas if on the contrary they actually entered those cavities of the face to effect it, they must deposit them all, and in one subject, the improbability of which in respect to the other species is already stated.

Of the Larva. From one to seven or eight are generally found in the cavities of the face, what are called by anatomists of the human, the maxillary and frontal sinuses, but which in quadrupeds are cavities of considerable extent and magnitude, and the thin flexible bones which constitute them are covered with a

dense white membrane, upon the secretions of which they feed, and these membranes are found more or less inflamed by their presence.

Vallisneri has remarked, that Alexander Trallien, a famous Greek physician of the sixth century, relates the following anecdote, which has an undoubted reference to these larvæ, that "Democrites, an Athenian, being subject to fits of epilepsy, determined to consult the oracle at Delphos for a remedy, and received for answer,

> "Quos madidis cerebri latebris procreare capella
> Dicitur humores, vermem de vertice longum."

An old man of eighty years, explained to him the fact of the existence of such worms, and pointed out the means of obtaining them by a sack tied about the nose of the sheep, into which they were received on falling from the sinuses. And this way also was employed by Vallisneri and Reaumur.

When young these larvæ are perfectly white and transparent, except the two horny plates, which are black. As they increase in size the upper side becomes marked with two transverse brown lines on each segment, the anterior one shorter and narrower than the posterior; and some spots are also seen on the sides. The body consists of eleven segments. See fig. 17.

I procured about the middle of June some full-grown larvæ of the Œ. Ovis, from the inside of the cavities of the bone which supports the horns of the sheep. They are nearly as large as those of the Œ. Equi, of a delicate white colour, flat on the under side, and convex on the upper; having no spines at the divisions of the segments as the Gastricolæ, but are provided with tentacula at the small end. The other end is truncated with a prominent ring or margin, which serves the same purpose in an inferior degree as the lips of the Œ. Equi and hæmorr-

hoidalis, by occasionally closing over, and cleaning the horny plate, from the mucus and pus of the membranes, with which it is subject to be smeared and prevented from performing its office. When this margin opens after closing over the plate, it occasions frequently a slight snap from the sudden admission of the air.

They move with considerable quickness, holding with the tentacula as a fixed point, and drawing up the body towards them. On the under side of the larva is placed a broad line of dots, which, on examination with glasses, appear to be rough points, serving perhaps the double purpose of assisting their passage over the smooth and lubricated surfaces of these membranes, and of exciting a degree of inflammation in them where they rest, so as to cause a secretion of lymph or pus for their food.

I have mostly found these animals in the horns and frontal sinuses, though I have remarked, that the membranes lining these cavities were hardly at all inflamed, while those of the maxillary sinuses were highly so. From this I am led to suspect they inhabit the maxillary sinuses, and crawl, on the death of the animal, into these situations in the horns and frontal sinuses.

The breeds of these, like the Œ. Bovis, do not appear confined to any particular season, for quite young and full-grown larvæ may be found in the sinuses at the same time.

When full-grown they fall through the nostrils, and change to the pupa state, lying on the earth, or adhering by the side to a blade of grass. See fig. 18.

The fly bursts the shell of the pupa in about two months. See fig. 19, 20, and the veins of the wing, fig. 21.

On their Effects. The sheep are particularly subject to vertiginous diseases, which the agitations and irritations these animals occasion may tend to prevent. In the sheep it will be much more difficult than in horses to prevent or destroy them, particularly if they are seated in the maxillary sinuses: in this

case trepanning would be insufficient, as they would probably be concealed in the convolutions of the turbinated bones.

Perhaps the removal of the sheep to a distant pasture during the months of June and July, while the greatest part of the Bots are yet on the ground in the chrysalis state, and not bringing them on the pasture again till the setting in of the winter, would be the means of destroying them most effectually; and if repeated for two or three years in succession where they are particularly troublesome, the farmers might eventually find their account in it.

The male flies are found not unfrequently sticking to pales and walls about sheep pastures.

Some large flies living in the backs of animals have of late years been found in America, and have been referred to this family; I am, however, of opinion after more mature examination, that they are not truly Oestri, but should constitute a distinct genus; their bodies are for the most part without hair and smooth, and their antennæ plumated, in which they make an approach to the plumated division of the genus Musca, as the *Musca, Cæsar, Cadaverina, Vomitoria, Mortuorum, &c.*

For those I have seen I have been indebted to my much-esteemed friend, John Francillon, whose liberality and splendid collection of insects need not my poor encomiums; he received them from the American states of Georgia: and we are indebted for what we know of their habits to his ingenious correspondent, the indefatigable John Abbots, of the Savannah, who communicated drawings and the insects themselves to my friend.

I propose to give an outline figure of three species of this genus, from his cabinet, with the larva and chrysalis of one of them; and one new one from my own, which was purchased from Drury's Cabinet, being all the species I have hitherto seen.

The above indefatigable labourer in natural history in one of his communications states, that in Georgia these flies are termed the Rabbit Flies, as they infest the hares and rabbits of that country. "A rabbit being catched," he says, "I observed creeping out of the skin a worm, (see fig. 24,) which being full fed, went into the ground, the 2nd of August. It feeds between the skin and the flesh, seldom more than two at one time; it changed into chrysalis (see fig. 25,) and the fly appeared the 13th of the September following, by pushing out a kind of door, (see fig. 26.) The skin of the chrysalis was thick, and hard as wood. The fly when it came out had a kind of bladder to its mouth, &c." As the face of most flies on their issuing from the chrysalis is so inflated, there is nothing singular in this; that all which appears to be interesting in this communication is contained in the above extract.

I described one of these singular flies, the *Cuniculi*, in my paper sent formerly to the Linnean Society, and ventured to suggest, whether it might not be possible that these immense flies have formerly belonged to some of those large animals whose existence is no longer known, but whose bones are from time to time discovered in the earth in various parts of the globe, and that on their destruction they resorted to these small animals as a substitute of necessity.

We may remark in concluding this brief account of them, that if these insects should ever be brought to the aids of veterinary, or other medicine, their effects would be much more powerful than those of the Oestri, from their magnitude and roughness. For distinction I have conferred on them the generic name of *Cuterebra*.

OESTRUS. *Antennæ,* articulis tribus, ultimo subgloboso setâ anticè instructo, in foveis duabus frontis demersæ. *Os,* apertura simplex, neque ullo modo exsertum. *Palpi,* duo biarticulati, apice orbiculares in depressione utrinque oris siti. *Alarum* membrana laxa et subrugosa.

* *Famil.* GASTRICOLÆ.——CHYLIVORÆ.

Larvæ in Ventriculo Equi enutriuntur, stomachi interiori adhærent corniculis duobus falciformibus acutis utrinque oris sitis. Alarum tracheæ seu Trachypteræ usque ad marginem extremam alæ protenduntur. Corpus parcius pilis obtectum. Tab. I. fig. 16, 23.

1. *Equi.* Oestrus. Alis albidis, fasciâ mediâ punctisque duobus nigris extimis. Tab. I. fig. 13, 14.

Bovis Oe. Alis maculatis thorace flavo fasciâ fusca abdomine flavo apice nigro. Linn. Syst. Nat. p. 969. 1. Faun. Suec. 1730.

Raii Hist. Ins. p. 271. Musca bipennis *Oestrum* dictus.

Oe. Bovis Fabricii Sp. Ins. p. 398.

Oe. Hæmorrhoidalis. Gmelin Syst. Nat. p. 2810.

De Geer Hist. Ins. p. 291, pl. 15, fig. 16.

Geoffroy Hist. Ins. II. p. 456, n. 3.

Olivier Encyclopedie Methodique. Vide Estre.

Habitat in Pratis inter jumenta; deponit ova in Genubus, lateribus, jubâque Equorum.

Descrip. Apis mellificæ magnitudinis. *Caput* latum, obtusum *Frons* alba membranâ nudiusculâ, verticeque piloso, ferrugineo. *Oculi* nigricantes in fœminis minores et distantiores. *Antennæ* globosæ, compressæ c. setâ anticè porrectâ. *Thorax* griseus inter alas obscurior. *Scutellum* fasciculis 2. pilosis. *Abdomen* luteo-ferrugineum, maculis punctisque (in maribus precipuè) incisurarum nigris. *Alæ* albidæ neque diaphanæ quodem aureo colore relucentes cum fascia pone medium flexuosâ et in extremâ alæ maculis duabus rotundatis nigris. Punctum minimum atrum exstat in costâ versus basin alæ. *Pedes* palidiores, lutei, *Tarsi* simplices, *Unguiculis* atris incurvatis posticis divergentibus squamulisque duabus paleaceis clavatis.

Mas. Abdomen obtusum pube incurvatâ et forcipibus duobus atris transversis quæ vaginam muliebrem corripiunt et peni adducunt.

Fœmina. cum caudâ elongatâ atrâ, ultimum segmentum vaginale,

subcylindricum et supernè fissum quo modo comprimit, extruditque ovum.

Ovum, album elongatum apice in obliquum sectum, cum valvulâ larvam emittere.

Larva, cute densa tecta, ovata, teres, posticè truncata, antice capite attenuato ore longitudinali corneo labiis duobus et unguiculis duobus atris utrinque oris recurvatis quibus stomacho interno impendet. Ad marginem segmentorum spinis rigidis deorsum spectantibus duplice alterna serie obsita. Per menses duodecim nutrita et ad maturitatem perducta, a stomacho solvitur, per intestinos fertur tandem ano emissa, in humum decidit.

Pupa, ovalis, obscure rubra c. spinis brevibus rigidis uti in Larvis.

β. *Varietas* cum alarum apice maculâ unicâ tantum oblongâ et abdomine densé tecto pilis ferrugineis. Specimen vidi in museo Linneano quod certè varietas β. Fn. Suec. No. 1730.

Oe. Vituli! Fabricii Syst. Ent. VI. p. 231.

2. *Hæmorrhoidalis*. Oe. Alis immaculatis fuscescentibus: abdomine atro, basi albo apiceque fulvo. Tab. I. fig. 21, 22.

Oe. hæmorrhoidalis. Alis immaculatis thorace nigro: scutello pallido, abdomine nigro basi albo apiceque fulvo. Linn. Syst. Nat. II. 970. Fn. Suec. 1733.

Oe. Equi. β Fabr. Syst. Ent. Tom. 6. p. 232.

Oe. Bovis. Gmelin Syst. Nat. p. 2809.

Reaumur Hist. Inst. Tab. 35, f. 3. Larva T. 34, fig. 14.

Geoffroy Hist. Ins. 2, p. 455, n. 1.

Habitat in pascuis, deponit ova in labiis Equorum.

Descr. Oe. Equo dimidio minor. *Frons* alba tomentosa membranacea. *Oculi* fusci in fœminis lineâ nigrâ longitudinali. *Thorax* pilis flavo fuscis spatio inter alas atro, nudiusculo. *Scutellum* fuscum pilis albis porrectis obsitum. Abdomen atrum medio lucidum basi albis apiceque pilis fulvis. *Subtus* pilosus cinereus, pedibus pallidis longiusculis. *Alæ* aureo-fuscæ immaculatæ, membranâ vix rugulosâ. *Halteres* albidæ.

Fœminæ abdomen posticè elongatum, incurvatum, atrum; *maris* cum prehensoribus masculinis sub ventre instructum.

Larva alba spinigera simillima priori at minor.

Puppa ovata brunnea spinis brevibus incisurarum.

Ovum, atrum, petiolo elongatum.

3. *Veterinus.* *Oe.* ferrugineus, alis immaculatis lateribus thoracis, abdomineque basi pilis albis. Tab. I. fig. 26, 27.

Oe. nasalis. Alis immaculatis, thorace ferrugineo abdomine nigro pilis flavis. Lin. Syst. Nat. 969, 3. Fn. Suec. 1732. *Reaumur Hist. Ins.* tom. IV. p. 551. Pl. 35, fig. 3, 4, 5.

Habitat in Pascuis.

Descr. Oe. Equo minor, oblongior. *Caput, thorax*, et *abdomen* pilis ferrugineis tecta. *Alarum* ortus abdominisque basis pilis albis obsitæ. *Abdominis* segmento secundo magis gibbo quam in reliquis tuberculis duobus hirtis. Subtus ferrugineo fuscus. Pedes fusco ferruginei.

β Variat præcipue fœminis abdomine pene atro.

Larva elongata rubicunda glabra spinis minutis nisi ultimis duobus segmentis: in stomacho equi. Tab. 1. fig. 24.

** CUTICOLÆ.———PURIVORÆ.

Larvæ sub cute animalium enutriuntur. Alarum tracheæ seu Trachypteræ citra marginem terminant per anastomosin. Tab. 2, f. 10. *Squamæ halterum grandiores. Corpus valde pilosum.*

4. *Bovis.* Oes. alis immaculatis fuscis: thorace lineis quatuor interruptis glabris atris: abdominis apice pilis fulvo-flavis. Tab. 2. f. 8, 9.

Vallisneri Opere, tom. I. tav. 28. f. 10.

Reaumur. Hist. Ins. tom. IV. p. 503, tab. 38, f. 7, 8.

De Geer Hist. Ins. tom. VI. p. 297, pl. 15. f. 22.

Schaeffer, Ins. Ratisbon, tab. 89, fig. 7.

Fishcher, Dissert. inaug. tab. 3. f. 5.

Med. Com. Vol. I. Larvæ in Sinu frontis mulieris.

Anglis, Breeze, Brize, or Gad-fly.

Habitat in pascuis inter armenta in quorum dorso deponit ova.

Descr. Oe. Equo vix major fronte albâ, undique tomentosâ. *Thorax* anticè flavescens, in medio ater, lineis denudatis longitudinalibus quatuor, posticè cinerea. *Abdomen* basi cinereum fasciâ seu cingulo in medio atro, apiceque pilis fulvoflavis. *Squamæ Halterum* magnæ niveæ convexæ. *Pedes* nigri, tarsis pallidis.

Fœminæ abdomen, stylo attentuato atro, compressione evolvendo.

Mas. tab. 1, fig. 30, minor, abdomine obtusiore pube inflexo forcipibus masculinis. *Oe. Ericetorum.* Trans. Soc. Nat. Hist. I

Ericetis prima vere deprehensus a Dit. D. Leach prope Plymouth, Devoniæ, etiam prope Londinum. Anne distincta species?

5. *Tarandi.* Oe. alis immaculatis: thoraceque postice lineis brevibus glabris quatuor atris: abdomine fulvo. Tab. fig. 13, 14.

Habitat in Septentrionalibus. Larva in dorso Cerv. Tarandi.

Tarandi Oes. Alis immaculatis: thorace flavo fascia nigrâ: abdomini fulvo apice flavo. Lin. Syst. Nat. p. 969.

Flor. Lappon. 360, n. 517. Act. Upsal 1736, p. 31, n. 23. Act. Stockh. 1739, p. 121, tom. III. f. 5, 6. Lappis *Curbma* dicta.

Descr. Oe. Bovi simillimus at villosior. *Frons* flava pilosa vertice antennisque atris. *Thorax* major flavus latè in medio ater stigmatibus seu lineis elevatis, atris, 4, postice acutioribus. *Alæ* subdiaphanæ squama halterum maxima margine inflexa squamulaque insuper basin minori corrugata. *Abdomen* attenuatum saturatè fulvum hirsutum, basi thoraceque posteriùs albidis. *Pedes* atri tibiis inferiùs pallidis. *Tarsi* rufi c. unguiculis longioribus, tenuibus divaricatis.

*** CAVICOLÆ.———LYMPHIVORÆ.

Larvæ in Cavitatibus Frontis Ovis Alarum Tracheæ, seu Trachypteræ ad marginem alæ tenuiorem haud pertingant nisi unicam, basis alæ c. lobo reniformi vesicaque parva crenulata. Corpus lævet uberculis setigeris.

6. *Ovis.* Oes. Alis pellucidis basi punctatis: abdomini albo nigroque tesselato versicolore.

Habitat inter *pecora* deponit ova in margine narium.

Ovis Oe. Alis subpunctatis abdomine albo nigroque versicolore. Lin. Syst. Nat. p. 970. 5.

Vallisnere Opere, tom. I. t. 27.

Reaumur Hist. Ins. t. 35, f. 22. Larva 8, 9.

Geoffroy Hist. Ins. II. p. 456, n. 2.

Descr. Oe. Equo minor, pilis scatentibus paucis, vertice capitis punctis excavatis. *Thorax* cinereus, punctis elevatis atris, setigeris, lineisque quatuor nigris. *Abdomen* colore albido-cinereum nigro maculatum fugaci. Supra aperturam oris processu parvo conico.

Larva alba ovata, anticè acuminata unguiculis duobus, posticè truncata margine prominenti et squamulis duabus atris respiratoriis.

Supernè convexa lineis punctisque nigris. *Subtus* plana in medio segmentorum punctis asperis atris minutis notata. Pectus subtus appendiculis 4 palpiformibus anterioribus longioribus.

Habitat intra cavos frontis ovium, evaditque per nares.

7. *Cervi.* Oe. ——— ——— ——— Reaumur. Ins. Tom. V. p. 67. Pl. IX. fig. 2, 6.

Habitat Larva in Cavitate Pharyngis Cervorum.

Valde convenit cum Larvâ Oestri Ovini at major.

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8. *Stimulator.* Oe. flavescens pilosus alarum basi thoraceque in medio atris.

Tab. I. fig. 28. Alarum tracheæ f. 29.

Oe. Pecorum. Fab. Syst. Ent. *trompe*? Ejusd.

Oe. Microcephalus. Dissert. preced. nostri.

Habitat in septentrionalibus.

Descr. Muscæ bombylantis magnitudinis et staturæ. Frons uti in muscis provenit, in medio os absque proboscide barbâ albâ, vertice pilis flavescentibus. *Oculi* fusci nigro nebulosi cinctoque. *Antennæ* globo atro setâ porrectâ. *Thorax* hirsutus, flavescens ad incisuram mediam, exinde ater, etiam alæ insertio atra subnudus posticè et scutello subnudo circumcincto pilis cinerascentibus. *Squama Halterum* perlucidum decoloratum neque magnum. *Alæ* venis nigris abbreviatis conspicuis posticè denticulatis.—*Abdomen* breve subglobosum pilis parciùs tectum rufo-cinereis utrinque basi et posticè pilis subfulvis; *subtus* pilis cinereis hirtum in medio atrum denudatum. *Pedes* omnino c. tarsis atri.

9. *Phobifer.* Oe. ater, alis plaga nigricante: thorace abdomineque posticè rufis. Tab. 2. f. 30.

Habitat in Georgiâ Americanâ I. Abbott. In museo amiciss. I. Francillon.

Descr. Magnitudo muscæ tenacis at gibbosior uti in Oe. hæmorrhoidali et forsan ejusdem familiæ. *Oculi* fusci. *Thorax* rufus utrinque pilosus uti scutellum. *Alæ* a basi ad medium linealata seu plaga nigricante ad costam, aliter diaphanæ parum puculatæ. Squama halterum major diaphana. Abdomen atrum pilis fulvis seu rufis tectum precipue ad extremitatem.

CUTEREBRA. *Os*, haustello corneo brevi in Fissura capitis recondito. *Antennæ* triarticulatæ, ultima articulatio ovata, setâ instructa plumosâ. Palpi nulli.*

1. *Cuniculi.* Cu. nigra, thorace piloso lutescente in medio latè antice nigro.
Habitat in Cuniculi et leporis dorso Americes. Tab. II. fig. 26.
Descr. Magnitudo, apis terrestris nostræ. *Caput* nigrum oculis fuscis fronte porrectâ. *Thorax* flavus hirtus antice ad medium macula magna atra rotundata. *Scutellum* flavum. *Abdomen* nigrum basi et lateribus segmentorum flavis. *Alæ* fuscæ, lobo baseos obscuriore. *Subtus* nigrum flavo variegatum. *Pedes* nigri, tarsis latioribus. *Larva* fusca undique muricata aculeis minutissimis; fig. 24. *Pupa* fusca exasperata posticè aperturis duabus luteis respiratoriis. Tab. II. fig. 25.

2. *Horripilum.* C. nigra, thorace, abdominisque primo segmento pilosis flavis.
Habitat in Georgiâ apud Savannah Americes. J. Abbott. Tab. II. fig. 27.
Descr. Magnitudo et statura omnino præcedentis at thorace absque macula ista magna nigra quæ ex aliquo casu denudasse suspicor.

3. *Cauterium.* C. atra lævis, thoracis lateribus luteis, punctis tribus atris.
Habitat in Americæ sylvis prope flumen Ogeechense. J. Abbott. Tab. II. fig. 28.
Descr. Minor C horripilo, *Caput* atrum thorace latius. *Oculi* grisei, albo punctulati, orbitum anterius striis 4 niveis, inferius utrinque oris luteum. *Thorax* ater lævis convexus ad latera flavo vellere tectus punctis tribus et orificio respiratorio atris. *Abdomen* nigro-cyaneum infra atrum, punctis pallidis irroratum et ultimum segmentum-utrinque. *Alæ* nigricantes quam in cæteris obscuriores. *Pedes* atri lucidi.

4. *Purivora.* C. cœruleo alba, Thorace capiteque punctis atris.
Oestrus buccatus. Fab.
Habitat in Americâ. J. Abbott. Tab. II. fig. 29.
Descr. C. cauterio major, valde gibbus. *Caput* magnum thorace latius, insuper atrum lucidum punctulatum maculis duabus in vertice, et quatuor ante oculos majoribus, albis. *Frons* parte inferiori cœruleo-alba seu argenteo-cœrulea, punctis lucidis octo atris, medium par inferiorum quasi palpos æmulantes, cum petiolo

* Corpus hujus generis muscarum lævius et cataphracta duriore obtectum precipue abdomine. Alæ in omnibus mihi visæ coloratæ, lobo baseos dissecto rotundato, et a posteriori thoracis parte prodeuntes.

scissuræ connexo. *Thorax* cœruleo-incanus anticè lineis obscuris nigris ad latera villosior maculis tribus atris. Scutellum lineatum supereminet abdomen. *Abdomen* atro-cœruleum lateribus posticeque cœrulescentibus nigro irroratum. *Pedes* nigri femoribus rubris. *Alæ* fuscæ lobo baseos dissecto nigricante.

OESTRUS. *Antennæ* with three articulations the last globose with a bristle in front deeply sunk in the head. *Mouth* a simple aperture without a trunk. *Palpi* two, of two articulations, last rounded, situated in a depression on each side the mouth. *Membrane* of the wings lax and puckered.

* Stomach Bots.

1. *Equi.* *Oe. The Knee Bot, or great spotted Horse Bot.* Wings opake white, with a golden tinge, a transverse black wave and two spots near the extremity: a minute black raised dot near the base of the wing. Abdomen reddish brown, with black spots and points. Legs red. *Female* with lengthened abdomen, curving underneath: *male* obtuse.

In meadows, laying its eggs or nits on the knees, mane, and sides of horses.

Egg white, oblong, pointed, the other extremity obtusely truncated with a lid. *Larva* or *Grub* barrel-shaped, at one end tapering, obtuse at the other, covered with a thick skin, beset with a double row of prickles round each joint, alternately placed.

In the stomach of the horse, to which it adheres by two short black hooks, one each side the mouth.

The *Pupa* or *Chrysalis* oval, dark red, rough with prickly points, under dung.

2. *Hemorrhoidalis.* *Oe. The Lip* or *Fundament Bot.* Wings without spot, brown. Face white, antennæ in a black pit or depression. Body thinly covered with hair, greyish in the middle of the thorax and abdomen black shining, base of the latter white, and extremity red orange. Beneath grey, hairy. Legs pale red.

In meadows, laying its eggs on the lips of the horse.

Egg black, oblong with a petiolus or foot stalk.

Larva white, with spines or prickles like the former, but less and rounder.

In the stomach of the horse. *Puppa* red brown with small prickles round the segments.

3. *Veterinus.* *Oe. The Red, or Breast Bot*.* Wings clear, unspotted. Body oblong, tapering, covered with reddish yellow hairs; sides of the thorax and base of the abdomen with white tufted hairs.

In meadows. *Larva* oblong, coral red, smooth joints, rounded, two last dark red.

In horses stomachs.

** Skin Bots.

4. *Bovis.* *Oe.* Ox Bot or Gad Fly. Wings brownish unspotted. Thorax with four smooth raised lines. Abdomen, base white, middle black, end orange red. Legs black, with red feet. In meadows.

Larva or grub in the backs of cows. White, with eleven segments or divisions, with a narrow and a broad line of rough points on each.

β *Vernalis*, Small Ox Bot. Less than the former; colours more obscure. I possess both male and female; whether a distinct species or a variety produced by season, I am unable to determine. It also is found in America.

5. *Tarandi.* *Oe.* Rhein-deer Bot. Wings immaculate. Thorax with four raised short lines. Abdomen with orange hairs. Like the former, but larger, more hairy, and of a darker orange. In Lapland, laying its eggs on the back of the rhein-deer.

Larva white, black at the extremity.

*** Face Bots.

6. *Ovis.* *Oe.* Sheep Bot. Wings transparent, minutely spotted near the base. Abdomen reflecting white and black according to the light, in squares. Thorax with raised black dots. Among sheep, laying the egg on the margin of the nose. *Larva* white, with black transverse lines and spots in the frontal cavities of the sheep

* In the cabinet of my esteemed friend, J. Francillon, there are specimens, sent by J. Abbott from America, which I take to be of this species, though somewhat smaller, and the colours much more obscure. He observes, that the parent fly lays its eggs on the breast of the horse.

FINIS.

W. Flint, Printer, Old Bailey, London.

Discovery of the Fly of the White Bot, from p. 34-5.

SINCE the above account was printed, I have been successful in obtaining from this white larva the perfect fly, which proves a new and hitherto unknown species. This object I accomplished in the following manner.—I procured from the slaughter-house a piece of the stomach of a dead horse, having a cluster of these white Bots hanging to it, and aware of the difficulty, perhaps impossibility, of nourishing them to their full growth out of their natural abode, I rolled them up in the piece of stomach to which they were adhering, without detaching them, and forced them with a light hand down the throat of my own young horse, who seemed no way incommoded by the experiment. The dead portion of stomach would soon be dissolved in the juices and actions of the living stomach, and the Bots set at liberty would by their hooks take fresh hold, and anchor themselves upon the stomach of my own horse. Transferred to their new residence, I had only to wait their full growth and exit to obtain them. About the 20th of the fifth month (May) the first made its appearance, falling with the dung from the intestines. By a reward offered for each, my groom was made quick-sighted, and in this way I secured twelve or fourteen more. They continued to come away to the end of the month following, and these larvæ being placed on some light mould in a jar, buried themselves, and in a few days changed to the chrysalis.

It is remarkable, that they generally came away from the horse in a morning, and not at any other time of the day, nor did they in the least adhere to the anus in their exit, as the hæmorrhoidal Bots do. I also noticed that they lived in distinct colonies or separate clusters, in the stomach not mixing with the *Equi* and *Hæmorrhoidales*. And this species I believe it is that I have seen out of the stomach at the entrance of the duodenum. After waiting with the earnest desire of seeing the fly for about ten weeks, one at last made its appearance, a figure of which is given Pl. I. fig. 35, 36, and of the larva and chrysalis. fig. 33, 34.

I cannot forbear to remark here, that the two short horns at the head or small end of the chrysalis, are in fact respiratory tubes, and serve to convey air to the included animal; and when we open the chrysalis we may observe two very thin membranous tubes connected with those, which appear passing down on each side of the head, as though going to the thorax, and I suspect meet and inosculate with the respiratory foramen observable in the side of the thorax, and is common to all flies. These tubes are, however, in the advanced chrysalis broken off; in the recent one they may, perhaps, extend to these foramina, they nevertheless may supply air to the cavity after they become ruptured. I notice this fact, and the probable solution of it, as the circumstance does not appear to have been before understood.

Some of these chrysalises not yielding their flies in due time, I amused myself one morning in opening one of them with the point of my penknife; some of them were really dead, but one being alive, no sooner felt the air and the light, than his head began to dilate in a most surprizing manner, by some fluid thrown into it from the thorax, which again subsided, and by these successive dilatations and contractions he moved in his shell, bursting a fine delicate membrane which enveloped his body. By these pulsations his thorax was at length delivered through the opening, and then obtaining the use of his legs, he completed his birth by crawling to the outside of his coffin, and taking a survey of this to him new, and, no doubt, extraordinary world, and from his dark and loathsome abode, in the stomach, to wing the thin air, and live in solar light. His wings next, folded up, and, limber, underwent the operation of expansion, and, as it appeared to me, from the injection of some fluid into their tubes or nerves, as we consider them; and this I am led to believe, because it appeared to me their gravity alone was inadequate to their expansion. This little exercise of the obstetric art with the penknife in opening the shell, did not in the least discompose the perfect developement of all the parts of the fly, and may afford a hint to those who may wish to be gratified with a view of this singular spectacle.

The following is a description of this new species.

Salutaris Oe. Alis immaculatis: thorace fulvescente: abdomine atro, basi albo, postice rufo: femoribus atris barbatis.

Habitat in pratis. Tab. I. fig. 35. *fœm. fig.* 36. *Mirandum est hanc muscam equum sub æstate titillatione exagitare et ad cursitandum incitare, nec non sub hyeme vereque larvæ ejus in stomacho perfricantis ope digestionem cibi expedire, ita duplici officio fungentem.*

Descr. Magn. ferè Oe. Equi. *Caput* parum sub thorace inflexum neque magnum c. facie et vertice pilis aurantiis tectis. *Oculi* fusci. *Thorax* major quam in cæteris speciebus et turgidus vellere virescenti-fulvo obtectus usque ad alarum insertiones, at inter alas ater et posticè ad latera c. albis et in medio, sive in scutello, pilis nigris. Pili etiam nonnulli albi ante ortum alarum. *Abdomen* atrum, visum inter pilos lucidum primo segmento pilis, albis precipuè ad latera; tribusque posticis in maribus rufis in fœminis vero cinereis obsitum. *Alæ* latiores parùm fuscæ venis ad costam subferrugineis et cum ipsa alæ insertione piceâ. *Pedes* fusci femoribus atris subtus conspicuè barbatis præcipuè anticis, character singularis hujus speciei. *Inferius*, caput, thorax, abdomen, latè in medio nigra. *Squama halterum* magnitudine mediâ, niveâ, ciliis extus albis.

β *Variat.* thorace toto rufo, c. Oestro Veterino valde congruens, at major et thorace robustiori.

Larva alba, ovata obtusa, spinis segmentorum albis serie unicâ tantùm. In stomacho et rarius in Intestinis Equorum, Tab. I. fig. 33.

Pupa ovata, obscura, spinis adpressis, basi gibbis.—Quies dierum 70. Tab. I. fig. 34.

Hæc species convenit in descriptione c. Oe. Hæmorrh. at triplo major, hirsutior, et coloribus splendidioribus, larva etiam diversissima.

Alia etiam occurrit musca bis minor Oe. salutari alis minimè coloratis, limpidissimis et tenuissimis thorace rufescente abdomine nigro pilis cinereis sparsis hirto. Olim mihi habita pro Oestri Veterini fœminâ aut varietate ejus incertus sum si sit distincta.

ENGLISH.

Salutaris Oe. White Bot Fly. Wings without spot, brownish, anteriorly ferruginous, their insertion black. Head bent under the thorax. Thorax very convex and large, with red orange hairs on the anterior part, between the wings black, posteriorly on the sides white, and before the wings some white hairs. Abdomen black, shining, first segment white, three last red, in the females grey.

I am enabled to add a new species to the division of the Face-Bots, communicated by my kind friend, Dr. Leach; a drawing of it was received from Paris from *J. J. Savigny, Membre de la Commission Egyptienne, Legion d'Honneur, &c.* It is stated to have been taken in Syria, and that it infests the antelope there.

Titillator. Oe. Thorace cinereo, abdomine rotundato albo segmento primo atro.
Habitat in Syria. Tab. II. fig. 22.

Descr. Oe. Ovino bis minor. *Caput* griseum stemmatibus tribus atris. *Thorax* cinereus. *Abdomen* breve rotundum album primo segmento totius atro. *Alæ* albidæ venis crebris ad costam fuscescentibus ultra medium abruptè desinentibus c. venis transversis crassioribus coloratis. *Pedes* rufescentes annulis duobus tibiarum nigris. *Scutellum* griseum punctis lineisque duobus flexuosis nigris.